MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 39 FEBRUARY, 1933 Number 6

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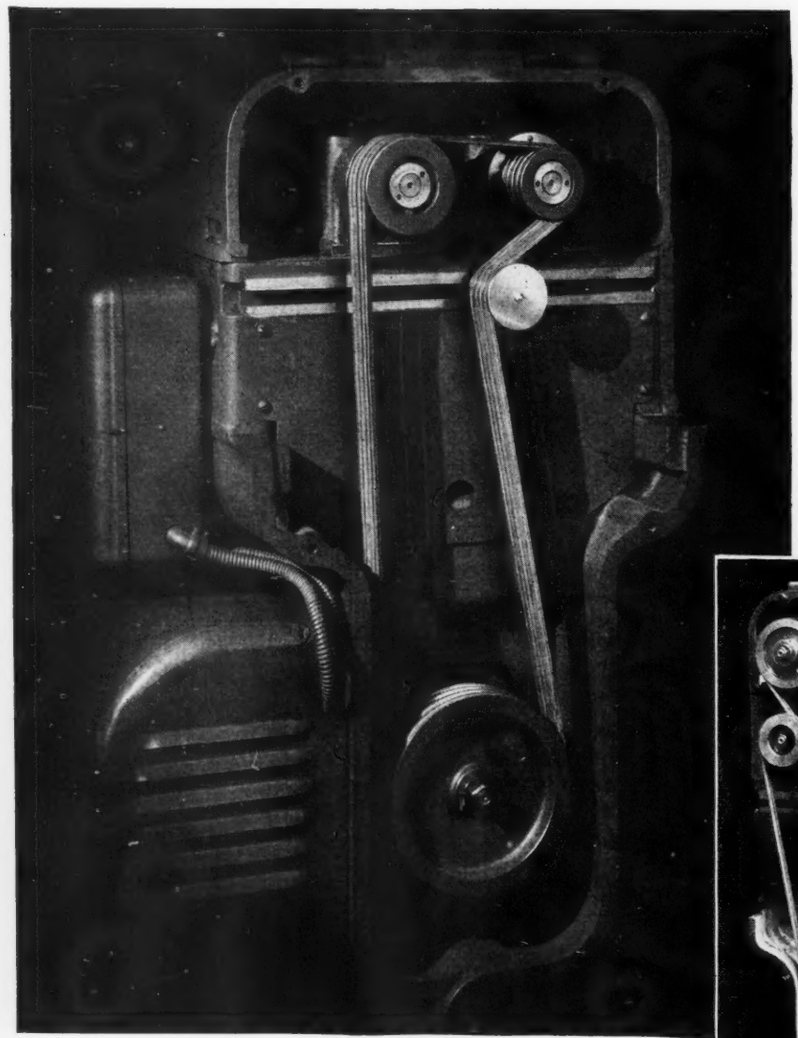

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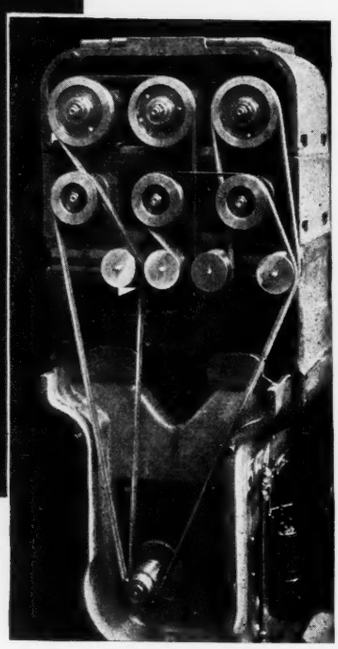

IN precision boring with diamond or tungsten carbide tools, one of the most important factors for success is the correct speed of the boring spindle. This varies both in regard to size of hole, material to be bored and amount of stock to be removed. On the Heald Bore-Matics, boring heads can be easily varied from a few hundred to 5000 R. P. M. by simply changing size of pulleys.

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Branch Offices at Chicago, Cleveland, Detroit and New York

HEALD

MACHINERY

Volume 39 NEW YORK, FEBRUARY, 1933 Number 6

Cutting Steel Under Water

By Using a Torch that Maintains its Flame When Completely Submerged

By CHARLES KANDEL, General Manager
The Craftsweld Equipment Corporation, New York City

ABOUT seven years ago, a tragic event occurred that shocked the world—the U. S. Submarine S-51 sank off Block Island after a collision, with a loss of thirty-four men. In trying to salvage the ship, it became evident that a satisfactory means of cutting steel under water would be of great value, and Commander Edward Ellsberg, salvage officer, therefore undertook to develop a cutting torch that could maintain its flame when submerged in water. With this torch, the raising of the sunken craft was soon accomplished. Since that time, this cutting torch has found wide application in the engineering field, in both construction and salvaging work, as will be described later in this article; but first, a statement of the events leading to the development of the torch, prepared by Commander Ellsberg, at the request of MACHINERY, may be of interest:

Commander Ellsberg Tells How the Under-Water Torch Came to Be Developed

"In September, 1925, the United States Submarine S-51 was sunk by a collision in 135 feet of water some fifteen miles to seaward of Block Island, with the loss of practically her entire crew. While no vessel of that size had previously been raised from a depth like that in the open sea, the disaster caused such a storm of criticism that the Navy Department was determined to raise the ship, and a salvage expedition was fitted out for the purpose.

"The few divers available in the service who could work at that depth were sent to the *Falcon*, the Navy's salvage ship, and work started. I was designated as salvage officer, and the squadron engaged in the operation, consisting in all of four vessels and one submarine, was under the command of Captain Ernest J. King, then Commandant of the Submarine Base at New London, Conn.

"Work at the sea bottom proceeded very slowly because of the lack of deep sea divers, frequent storms, the hazards of working at the depth at which the submarine lay, and the lack of adequate means of getting through the wreck and at the various parts of the hull, for clearing away obstructions and sealing up. At considerable risk, the divers managed to accomplish some work toward the end desired, until December gales finally drove us off, but it was then obvious that the undertaking would not be successful without additional deep sea divers, and a reliable means of cutting steel under water.

"During the winter of 1925, therefore, a diving school was started at the New York Navy Yard, and there I undertook also to provide the essential cutting tool. The idea of cutting metals under water was not new. It had been done after a fashion with an electric arc, and also by various adaptations of the acetylene torch. Actual experience in deep water, however, had shown that the available implements were practically useless because of the handicaps under which a diver is compelled to labor.

"Work was, therefore, started to develop a torch using hydrogen as the fuel gas, and a long series of experiments was carried out by divers, including myself, to discover the necessary practical changes that would produce a reliable underwater cutting torch. Numerous designs of tips, heads, and jackets were made and tested. We had some explosions and numerous flashbacks. On one occasion we found ourselves with a diver holding a torch blazing fiercely in his hands, and in grave danger of being burned to death, under sixteen feet of water in the experimental tank. It soon became apparent that the ordinary laws and experience governing combustion at atmospheric pressure with regard to gas velocities, speed of flame propagation, and combustion temperatures suffered radical changes when subjected to the pressure at the sea bottom and submersion in ice water.

Fig. 1. Ready to Go into Deep Water for Cutting away Steel Obstructions by the Use of a Torch Employing Oxygen, Hydrogen, and Compressed Air

"Failures and disappointments were numerous, but the urgent need for the instrument made us keep up the struggle, and before the winter was over a very simple torch using oxygen, hydrogen, and compressed air had finally been perfected, and several divers besides myself had become competent operators.

"With this tool and a much increased force of divers the expedition went back to Block Island, and on the sea bottom there, at a depth of 135 feet, I had the satisfaction of personally trying out the torch and using it successfully on the first cutting operation ever done in deep water with a flame. The job involved cutting through the 2 1/2-inch

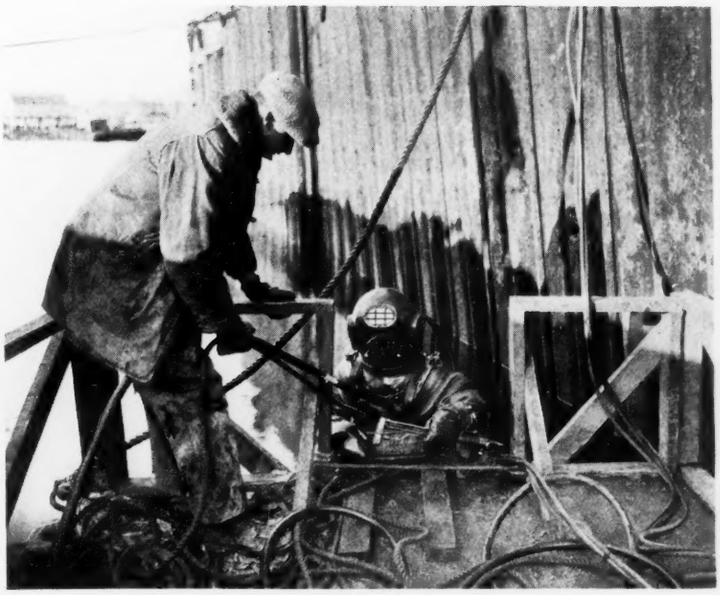


Fig. 2. The Torch that the Diver Holds in His Left Hand May be Ignited While Submerged or Before Being Carried into the Water

thick links of an anchor chain used on the starboard quarter of the S-51 to secure a pontoon to her. With the assistance of Chief Torpedoman John R. Kelley the job was quickly performed, and we were in possession of a quick means of solving many of the previously insuperable problems of salvage.

"On July 5, the S-51 was successfully raised and brought in, a tribute both to the courage and skill of the divers on that job and to the tenacity with which they stuck to it under heart-breaking conditions. It is a source of pleasure to those engaged there to realize that not only did the drive for safe submarines start with the officers of that expedition, but that many of the devices worked out at that time have been of benefit to all subsequent marine salvage jobs and diving operations, and have gone even further to be of general value in the solution of numerous problems in commercial engineering and construction work, far from the sea bottom."

How the Ellsberg Torch is Used

In the hands of a skilled diver trained in its use, the Ellsberg torch will cut steel of any thickness at any divable depth and with the same cutting speed and accuracy as an oxy-acetylene torch on the surface. Its operation is limited only in the same sense as other operations carried on under water, the limitations being due to the diver's cumbersome dress and weight, the difficult position he may be forced to assume while working, the limited visibility prevailing under water, and the effect of low temperature, current, tide, or water depth upon the diver's movements and endurance.

The torch is about the same size and shape as an ordinary oxy-acetylene torch and has only a few ounces of added weight. It may be seen in Fig. 1 in the right hand of the diver. Hydrogen is used as fuel instead of acetylene because of its greater stability at higher pressures.

In any gas cutting torch, one half of the oxygen needed for complete combustion is supplied through the torch inlet in the form of pure oxygen, while the other half is taken from the atmosphere surrounding the flame at the end of the nozzle or tip. To maintain combustion under water, it is necessary to create an artificial atmosphere around the flame that contains the necessary oxygen in the correct proportion. This is accomplished with the Ellsberg torch without in any way impairing the access of the flame to the work. The point of maximum heat at the outlet of the torch nozzle can be applied directly to the work, preheating the metal

Fig. 3. One Span of a Railway Bridge that was Carried away by a Flood. The Torch was Applied to Cut away the Sunken Members 20 Feet Below the Surface

almost instantly and proceeding to cut with maximum speed. The diver has a clear vision of his work and this insures rapid progress in the cutting operation.

The Torch Can be Lighted Either Above or Below the Water

An electric igniter which operates on an ordinary lighting circuit enables the diver to light the torch below water at will. The torch can also be lighted on the surface of the water in the usual way and lowered to the diver or carried by him to his work.

The consumption of oxygen and hydrogen varies with the character and thickness of the metal being cut and with the depth of water at the point of operation. However, it is only slightly higher than would be consumed on the surface with the same size of nozzle. The control of the gases is in the hands of the diver at all times; he can shut the valves at will and re-ignite the torch when ready to resume cutting.

Industrial Jobs on which the Torch has been Used

Many of the industrial jobs to which the torch has been applied have interesting stories behind them. For instance, in one of the New England States a railway bridge was swept away by a flood and carried into a lake. Some of the structural members extended slightly above the surface and while they did not constitute an actual menace to the operation of speed boats, still the railroad company soon became a defendant in a number of suits, for even when a boat was damaged by colliding with a boulder near the shore, the blame was laid to the partially submerged bridge members.

The railroad company decided to clear away the sunken bridge and did so by applying the Ellsberg torch extensively on a line 20 feet below the lake surface. Fig. 3 shows the end support of a 90-foot span as it projected above the water. The diver is directly below, engaged in cutting this portion of the bridge free.

Fig. 4. Two Structural Sections Cut at the River Bottom from a Dynamited Bridge Like that Seen in the Background

In a Western state, three spans of a highway bridge, each 75 feet long, were dynamited and blocked the channel of the river beneath. The channel was completely cleared of its obstruction by the use of the Ellsberg torch. Fig. 4 shows two structural sections of this bridge lying on a barge after they had been cut loose and raised from the river bed. In the background may be seen the new bridge built to replace the one that was dynamited.

In a Southern state it was found impossible by ordinary means to remove six 48-inch wide girders from a caisson at a depth of 90 feet below the surface of the water. Some of these girders had been dynamited to loosen them from the river bottom, but without success, as they were embedded in quicksand at the ends. With the use of the Ellsberg

torch, the girders were cut loose and soon raised to the surface. In Fig. 5 one of the sections may be seen lying on the river bank.

Another interesting industrial job was one in which over 1000 tons of sheet steel piling were cut at depths varying from 10 to 75 feet. Still another job in which the torch proved invaluable consisted of cutting a 90-ton section from a submerged ship hull. Fig. 2 shows a diver descending from a float to cut away a long steel bulkhead.

The actual operation of this cutting torch in all industrial projects has been carried on either by John R. Kelley (mentioned in Commander Ellsberg's statement) or under his direct supervision. Mr. Kelley, who is shown in the illustration Fig. 1, was decorated by the United States Government for his work as diver and under-water torch operator in connection with the salvaging of the U. S. Submarines S-51 and S-4.

Fig. 5. Part of a 48-inch Girder (Previously Dynamited) Cut in Two by Means of a Torch at the Bottom of a Deep Caisson

The Complete Cutting Outfit Can be Packed in Two Handbags

The complete outfit for cutting steel under water weighs about 75 pounds and can be carried in two handbags. It consists of the torch, an assortment of tips, hydrogen and oxygen manifolds with regulators, a compressed air regulator, several lengths of hose for operating at a convenient distance from the base, and the under-water torch lighter. Diving apparatus is, of course, also required.

Powerful Jetting Nozzle and Submarine Searchlight are Valuable Aids in Operations Under Water

Two other tools that were indispensable in the salvaging of the S-51 and that are now available for industrial use are a balanced high-pressure jetting nozzle and a submarine searchlight. The nozzle, though weighing only about 10 pounds, is capable of delivering water at any pressure up to 300 pounds per square inch without recoil. In fact, the nozzle is slightly self-propelling, so that the diver can hold it in one hand while discharging a jet of water powerful enough to break up and remove sand, gravel, and even hard-pan, or to move and scatter the toughest clay or the finest mud and silt. The water under pressure is supplied to the nozzle through ordinary hose having a 2- or 2 1/2-inch coupling.

The submarine searchlight weighs only a few ounces more than the light bulb itself, yet it is an effective aid to the diver when engaged in close inspection or in operations at night. It takes a light bulb of 300 watts.

* * *

Let each individual, each business, plan to meet its own problems under conditions as they *are*, not as we hope they will be. . . . Let's look ahead—and do the next thing next.—*Charles Benedict in the Magazine of Wall Street*

How to Obtain Best Results in Roll-Grinding

Second of a Series of Five Articles Giving Complete Directions for Roll-Grinding Operations and Wheel Selection

By H. J. WILLS, Engineer
The Carborundum Co., Niagara Falls, N. Y.

THE first article in this series, published on page 310 of January MACHINERY, dealt with general considerations in roll-grinding. In the present installment the selection of the wheels and factors affecting good grinding will be considered. It should be emphatically stated, in dealing with the subject of wheel selection, that perfection in roll-grinding is influenced to a greater extent by grinding machine conditions, good dressing practice, roll characteristics, and wheel manipulation than by wheel selection or by variations encountered in wheels.

There are a few basic theories of grinding that are worthy of attention before considering the selection of wheels by grit and grade.

Wheel Stresses and Their Effect on Wheel Selection

A grinding wheel must operate in such a manner that the stresses set up by the wheel rotation and the work pressures at the grinding face are close to the ultimate impact resistance of the bond and grain structure. A slight increase in pressure beyond this point will break or dislodge the grains, while less pressure will cause dulling of the crystals and glazing. In other words, any reduction in working stresses will cause the wheel to act "harder," and any increase in working stresses will cause the wheel to act "softer."

One point that should be emphasized is that a grinding wheel cannot be subjected to variation in working stresses without sacrificing either cutting action or abrasive material.

The relation of wheel speed to work speed determines the shearing force. As the wheel speed is increased relative to the work speed, the stresses set up between the work and the wheel face are lessened, and the wheel is not broken down so rapidly as under lower wheel speeds. As the work speed is increased relative to the wheel speed, the stresses set up between the work and the wheel face are increased, and the wheel is broken down more rapidly. A proper ratio or balance must be arrived at between the wheel speed and the work speed for economical wheel operation.

The rate of traverse or cross-feed accounts for another shearing force acting on the wheel face and is also a factor in the compressive force exerted on the whole or a portion of the wheel face. Rapid traverses, therefore, permit harder wheel gradings, and slower traverses, softer gradings.

The physical properties—principally ductility, hardness, tensile strength, etc.—of the materials being ground are factors affecting the shearing force on the wheel face. In other words, a hard tough roll requires a comparatively soft wheel. It is generally accepted that as grit size decreases in any given wheel grade, the wheel action becomes harder. This, however, is affected by bonds, metal characteristics, etc.

The area of contact between the work and the wheel face affects the compressive force acting on the wheel face. Consequently, the wider faced and larger diameter wheels are usually of soft grade.

In service, the abrasive wheel is constantly diminishing in diameter, and, as a consequence, the relation of the wheel speed to the work speed is constantly changing. The reduction in diameter of the abrasive wheel also constantly operates to decrease the arc of contact between the wheel and the work. As the abrasive wheel diminishes in diameter and the work speed remains constant, the wheel will act "softer"; and, if the grade strength has been properly balanced against the initial work and wheel speeds, the wheel will probably show excessive wear under the increased stresses imposed. This is also true when smaller diameter rolls are being ground.

The reduction in wheel diameter also decreases the area of contact, affecting the wheel action. The degree to which the action is affected will depend on the characteristics of the abrasive wheel used. Wheel and work speeds should be adjusted to compensate for the variation in stresses caused by this reduction in wheel diameter.

Finishing cuts can be improved with narrow wheels and decreased wheel speeds. To avoid changing to narrower wheels for final passes for each roll, it is satisfactory to under-dress the wheel face to the desired width. This, in effect, softens the wheel grading, which offsets the harder action of the lighter finishing cuts, thus avoiding a burnishing action.

Allowing for the conditions mentioned, large-diameter rolls permit the use of wheels with softer bonds, owing to the greater area of contact between the wheel and the work. This also applies to wheels of wide faces, particularly those wider than 4 inches.

Many shops have a multiplicity of roll diameters to consider in selecting wheels. Obviously, any one grading will not be ideal for rolls of greatly different diameters. Fortunately, the effect of these different arcs of contact can be compensated for by a slight alteration of operating conditions. Thus, if it is necessary to change from a 30-inch-diameter roll to a 6-inch roll, the wheel action will be much softer. To restore the wheel to practically the same grade action as on the larger roll, one or more

changes may be resorted to, as follows: (a) Increased wheel speed; (b) decreased work speed; (c) decreased rate of traverse; (d) slight dulling of wheel by slow dressing; (e) lighter wheel feeds.

This also applies to diminishing wheel diameters, since the wheel becomes softer in action as the diameter decreases. In some cases, the wheel surface speed cannot be maintained by a change of spindle speed; or, if changed, the compensation from the change of wheel speed is not sufficient and other means of compensation must be resorted to.

The Influence of Vibration on Wheel Selection

Rigid, non-vibrating machine elements permit the use of soft wheels, with a resultant increase in production and without a loss of abrasive efficiency. Vibration has a tendency to break down the wheel, necessitating tougher bonds to compensate for the hammering action of the wheel on the work. In either case, the point of danger is the inability of the wheel to maintain accuracy over the length of the roll.

Selection of Abrasives in Wheels

For chilled iron rolls, silicon-carbide wheels are best where luster is desired, while aluminum-oxide wheels are effective for satin finishes. For hardened steel rolls, aluminum-oxide wheels can be used for roughing and finishing, except where a luster is desired, when a final finish may be obtained with a fine silicon-carbide wheel or aluminum-oxide wheels of special characteristics.

It is suggested that the finest practical wheels be used for all roll-grinding, since fine-grit wheels, through the presentation of a greater number of cutting points to the work, frequently increase production, create less heat, and leave better surfaces, thus reducing subsequent operations to a minimum. Coarse wheels may remove stock at a faster rate, but the subsequent operations are increased or lengthened, thereby affecting the speed of stock removal. This is particularly true in redressing rolls to remove marks or to restore surface or shape. Every wheel should be used both as a roughing and a finishing wheel for best results and economy.

Factors Affecting Good Grinding—Wheel Balance

Wheel balance is absolutely essential to good finishing. Balance should be assured before and after mounting. Wheel truing, of itself, will not necessarily balance a wheel. In fact, a truing operation, after the initial balancing, may throw the wheel out of balance; therefore, for high-grade grinding, it may be necessary to balance before and after the initial truing.

Careful maintenance of the parallel bars and rollers on the balancing equipment and of the temporary spindles used is of extreme importance, since these are subject to continued use and resultant wear or damage. Balancing, being a time-consuming and non-productive operation, might be slighted to the detriment of the results expected of the wheel. Grinding perfection is controlled by wheel balance, and time must be applied to careful balancing.

Whenever it is necessary to change wheels on their collet, it is advisable to mark both the wheel and the wheel collet (mount) in such a way that the wheel can be remounted in its former position, thus avoiding a complete rebalancing operation each time the wheel is mounted. Remounting should be done with the collet always in the same position in relation to its support. In fine grinding, wheel balance should not be neglected nor taken for granted.

Determining on the Best Traverse Speeds

General practice indicates that, for roughing, a traverse of from one-half to two-thirds of the wheel width per revolution of the work is best; and for finishing, a maximum of 1/4 inch per revolution of the work may be used. For final finishing cuts with ultra-finish wheels, the traverse should be at the absolute minimum rate.

Within a very recent period, there has been a decided tendency to select the finer grit wheels for all stages of roll-grinding. To utilize such wheels to the best advantage, it is desirable to use slower traverse rates than are provided on most grinding machines for both dressing and grinding. It is recommended that the traverse drive be reduced, when possible, to a minimum of 2 inches per minute.

At no time should the wheel be allowed to travel off the work for a distance of more than one-fourth its face, as there is a tendency to greater abrasive penetration at the roll ends due to the reduced area of contact and consequent unit pressures on the individual grains. Slack in the traverse should be taken up to avoid long dwelling of the wheel at the ends of the passes, the effect of which is to grind the ends under size and to glaze the wheel somewhat.

Importance of Wheel Dressing and Truing

The speed and quality of grinding is in direct proportion to the care and skill of the wheel dressing. The object of dressing is twofold: First, to true the wheel in order to obtain balance and concentricity (truing); and, second, to restore the cutting qualities of the wheel or to alter the cutting characteristics (dressing). The tool used must be of a high quality and the operation controlled by a skillful operator.

In grinding cast-iron rolls of any type, it is satisfactory to clean the wheel face with a Huntington dresser until scale and iron particles are removed and then complete the operation with a diamond. This should reduce the diamond cost.

All semi-finishing and finishing cuts require a smooth, but not a dull-faced, wheel. After truing or dressing, it is recommended that the wheel face

be smoothed and the edges rounded by precision means with a hand stone to improve the finish and to prevent traverse marks.

Coarse dressing tends to make the wheel act softer, and fine dressing makes it act harder. When a wheel is too hard, or it is desired to make a faster roughing cut, the tool should have a rapid traverse across the wheel with a deep penetration. Diamond cuts made with a 1/4-inch lead, forming a diagonal pattern, will change the wheel several grades.

The perfection of the wheel edges is a definite factor in fine finishes. When an edge is inclined to become ragged or tapered due to wheel softness, it is of advantage to bevel the advancing edges slightly deeper than the depth of cut and about one-sixteenth of the wheel face in width. This serves as a roughing face, while the flat acts to smooth up the work.

Causes of Scratches on the Work

Many annoying scratches or "fish-tails" can be traced to a coarse dressing of the wheel when the abrasive grains are only partially loosened. These will leave the wheel when they come in contact with the work, and roll between the wheel and the roll. Sometimes the grains may be pressed into the pores of the wheel by the use of a dull diamond, with the same result. After dressing, the wheel face and sides should be cleaned with a stiff bristle brush and plenty of clean water to remove any loose crystals. Hammering of the wheel on the roll may also loosen the grains, causing scratches.

The excessive dulling of wheels to create a glaze for final finish-grinding is to be discouraged, since it is necessary to retain a cut for true surfaces. It is far better to resort to a finer wheel or very slow traverse rates.

Diamond marks are among the most annoying of troubles encountered in any class of grinding. These are caused by too deep a penetration of the diamond or by too great a rate of traverse while dressing, thus creating a pattern on the wheel face which is transferred to the work. This pattern is generally in direct proportion to the penetration and traverse rate of the dressing tool. Most grinding machines do not have a slow enough traverse to eliminate this pattern and hand traverses must be used.

It is suggested, in addition to slow traverse and shallow diamond feed, that the dressing action take place only in the opposite direction to the traverse used on the roll immediately after dressing. Placing the diamond at 30 degrees with the horizontal plane, with the usual down canting, will be quite effective. For fine grinding, a final smoothing of the wheel face with a hand stone is recommended.

Faulty dressing or truing may often be traced to the fact that this operation is usually carried on at a location on the machine away from the grinding position. Naturally, the machine ways are not worn the same at this point, and the normal parallel relation of the wheel and the roll does not exist at the time of dressing. A tapered wheel face with a dragging edge is one result of this condition. A partial correction can be obtained by dressing the wheel exactly on the line of wheel-work contact.

The Influence of Work Temperature

In grinding, all rolls and coolants should be as near room temperature as possible. Considerable trouble may develop from differences in temperature, which cause unequal expansion and result in errors in dimensions. If, during grinding, the roll becomes warmer than the coolant, it is a sure indication that the wheel or its operation is faulty.

In grinding hollow rolls of thin wall section, it is advisable to fill them with water, using permanent or temporary filling plugs at the roll ends. Uneven spiral marks are sometimes caused by unequal temperatures in thin-walled rolls, and the suggestion given will be found to be an effective remedy.

The Wheel Approach Must be Carefully Handled

One point in grinding hardened steel rolls that cannot be over-emphasized is that of wheel approach. Wheels should be brought to the work with extreme caution, as the slightest excess wheel pressure will cause a surface burn that, while sometimes invisible, may develop into blisters or spalls after short service. When a wheel is brought to the roll suddenly, it frequently causes the wheel-spindle to spring, allowing the wheel to bounce on the roll and producing intermittent burned spots in a spiral path around the roll. Never bring the wheel to the work unless both are in motion and coolant is flowing on the point of contact.

Fortunately, most roll-grinding machines have sufficient power to provide for good grinding. However, excessive machine friction, low line voltage, belt or wheel slippage, etc., may cause speed variation which invariably results in wheel loading, discolorations, or uneven grinding.

The third installment of this series of articles, to be published in March MACHINERY, will give specific directions for the grinding of steel rolls, chilled iron rolls, jewelers' rolls, chromium-plated rolls, and paper-mill rolls.

* * *

The Automobile Industry in 1932

The total number of cars and trucks produced in the United States and Canada in 1932 was 1,436,000, according to figures published by the National Automobile Chamber of Commerce. Of these, 1,198,500 were passenger cars and 237,500 motor trucks. The total wholesale value of these cars and trucks was $784,500,000. There are approximately 21,000,000 motor cars and 3,230,000 motor trucks registered in the United States. The total world registration of motor vehicles is 33,000,000, which indicates that 73 per cent of all motor vehicles are used in the United States. The number of people employed in the motor vehicle and allied industries was 3,700,000.

MACHINERY'S DATA SHEETS 243 and 244

AVERAGE STRENGTH DATA FOR NON-FERROUS METALS—3

Material Letters (p) etc. Indicate Foot-notes	Elements Identifying Composition, Approximate Percentages				Tensile Strength, Pounds per Square Inch	Yield Point, Pounds per Square Inch	Elongation in 2 Inches, Per Cent
	Copper	Zinc	Tin	Lead			
Brass Rod (p)	60	39	0.7	0.3	60,000	30,000	30
Brass Wire	66	34	..	..	80,000	.....	..
Bronze Castings (q)	87	2	10	0.2	30,000	15,000	14
Valve Bronze	88	4	6.5	1.5	32,000	16,000	17
88-8-4 *Bronze*	88	4	8	..	35,000	15,000	15
Phosphor Bronze (r)	80	0.75	10	10	25,000	12,000	8
Gear Bronze (s)	89	....	10	..	35,000	20,000	10
Bronze Strip (t)	94	0.20	5	0.1	55,000	.....	15
Hard, Grade A	94	0.20	5	0.1	75,000	.....	5
Extra Hard, Gr. A	94	0.20	5	0.1	85,000	.....	2
Half-hard, Gr. B	91	0.20	8	0.1	65,000	.....	20
Extra Hard, Gr. B	91	0.20	8	0.1	100,000	.....	1
Ph. Bronze Wire (u)	94	0.20	5	0.1	115,000	.....	..
Copper Sheet, Soft	99.5	....	..	..	36,000	.....	25
Copper Sheet, Hard	99.5	....	..	..	40,000	.....	8
Copper Wire, Soft	....	....	..	..	37,000	.....	30
Copper Wire, Hard	....	....	..	..	60,000	.....	..
Lead Pipe	....	....	..	..	22,000	.....	..
Lead, Sheet	....	....	..	..	30,000	.....	..
Magnesium Alloys (v)	....	....	..	..	28,000	7,000	9
Mag. Alloy, Wrought (w)	....	....	..	..	40,000	28,000	10
Mag. Alloy, Cast (x)	....	....	..	..	35,000	18,000	2

(p) Naval brass for Tobin bronze rods for structural purposes and adapted to hot-forging. A S T M specification.

(q) S A E No. 62 general-utility bronze. Maximum iron 0.06 per cent.

(r) S A E specification No. 64. Phosphorus content, 0.05 — 0.25 per cent.

(s) S A E specification No. 65. Phosphorus content, 0.10 — 0.30 per cent.

(t) Phosphor-bronze commonly used for flat springs. S A E No. 77; Grade A, half-hard. Maximum phosphorus, 0.4 per cent in Grade A, and 0.2 per cent in Grade B. Maximum iron, 0.1 per cent.

(u) S A E No. 81. Primarily for springs. Contains up to 0.4 per cent phosphorus. Maximum iron, 0.10 per cent.

(v) Dowmetal casting, not heat-treated. Magnesium, 93.7 per cent; aluminum, 6 per cent; manganese, 0.3 per cent.

(w) Same composition as (v), but in wrought condition.

(x) Heat-treated Dowmetal castings for high yield point and hardness. Magnesium, 89.9 per cent; aluminum, 10 per cent; manganese, 0.1 per cent.

MACHINERY'S Data Sheet No. 243, New Series, February, 1933

PROPERTIES OF ZAMAK ALLOYS USED FOR DIE-CASTINGS

Metals Comprising Alloys	Composition of Zamak Alloys No. 2	No. 3	No. 5	No. 6
Aluminum, Per Cent	4.10	4.10	4.10	4.10
Copper, Per Cent	2.70	....	1.00	1.25
Magnesium, Per Cent	0.03	0.04	0.03	....
Horse Head "Special" (99.99+ Per Cent) Zinc	Balance	Balance	Balance	Balance
Average Values of Properties of Several Casts Determined Six Months after Casting				
Tensile Strength, Pounds per Square Inch	47,300	36,100	41,600	39,600
Impact Strength (Charpy) as Measured on 1/4 by 1/4 Bar	15.00	18.25	17.75	18.50
Elongation, Per Cent in 2 Inches	8.4	4.7	4.2	10.6
Compressive Strength, Pounds per Square Inch	93,100	60,500	87,300	91,700
Brinell Hardness	83	62	73	71
Specific Gravity	6.754	6.644	6.675	6.717
Melting Point, Degrees F.	733.6	727.9	726.9	731.8
Solidification Shrinkage, Inches per Foot	0.1492	0.1380	0.1385	0.1560
Modulus of Rupture, Pounds per Square Inch	116,000	94,700	105,200	102,800
Transverse Deflection, Inches	0.22	0.27	0.16	0.27
Shearing Strength, Pounds per Square Inch	45,800	30,900	38,400	38,000
Specific Heat, Calories per Gram per Degree C.	0.1047	0.0980	0.1024	0.1036
Thermal Conductivity, Calories per Sec. per Cu. Cm. per Deg. C.	0.253	0.273	0.256	0.266
Thermal Expansion, Inch per Inch per Deg. C.	0.0000277	0.0000274	0.0000274	0.0000278
Electrical Conductivity, Mhos per Cu. Cm. at 25 Deg. C.	144,402	155,302	150,532	151,111
Relative Fluidity in Seconds*	87 3/5	60 2/5	66 4/5	70
Fluidity Number†	114	166	151	143

*Time required for equal volumes to flow through standard orifice at constant temperature.
†Derived by dividing 10,000 by time, in seconds, to indicate comparative fluidity.

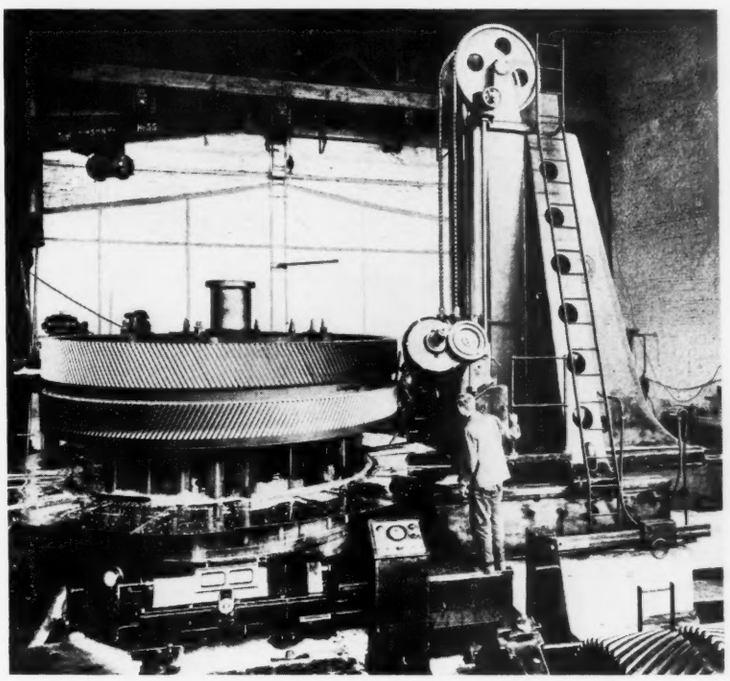
MACHINERY'S Data Sheet No. 244, New Series, February, 1933 Compiled by The New Jersey Zinc Co.

Notes and Comment on Engineering Topics

Every twenty-four hours, the railroads of the United States pay approximately $830,000 in taxes to national, state, and local governments.

Numerous oil seals have been developed to hold grease and oil in anti-friction bearings and keep out grit, dirt, and water. Some of these seals make use of treated cork, the interstices or air cells of which are hermetically sealed. This provides a pneumatic cushion that automatically expands and contracts with the changing temperature of the shaft or lubricant, thus always remaining oil-tight.

An oil retainer or seal recently developed for ball bearings is composed of two circular plates wedged together in a groove in the outer ring of the bearing. Contained between the two circular plates of the retainer is a wiper or ring of felt that makes contact with the inner race of the bearing or with the shaft. This felt wiper forms an oil-stop that retains the lubricant within the bearing, the construction being such that a constant pressure is exerted on the felt ring.



Gear Milling Machine of Huge Proportions Built by Schiess-Defries, Dusseldorf, Germany, Capable of Cutting Gears up to 16 1/2 Feet in Diameter and 7 Feet 3 Inches Wide. The 35-ton Double Helical Gear being Cut is for a 10,000-horsepower Rolling Mill Drive

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A pipe line 207 miles long, constructed of 26-inch steel pipe, has recently been completed in California for conveying natural gas. The pipe was made from flat plate in the shops of the Western Pipe & Steel Co., the plates being formed on bending rolls and then welded in a General Electric automatic arc-welding machine. The longitudinal seams were welded in 30-foot sections, two of which were then welded together into 60-foot lengths. In this form the pipe was shipped into the field, where the lengths were welded into one continuous line.

A truck or bus that can be operated either on the highway or on rails was recently demonstrated before railway officials at Chicago. Rubber-insulated flanged steel guide wheels are lowered into the guiding position when the coach is operated on rails. The manufacturer believes that freight-carrying coaches or buses of this kind can be operated successfully in the following manner: The buses would be loaded at the factories and driven through the streets to the freight yards, where they would be placed on the tracks and made up into trains numbering up to fifty buses. These trains would then be hauled by locomotives to the distributing points where the individual buses would again take to the highways and streets to deliver shipments from door to door. Similar vehicles have been developed and used in England for some time for commuter passenger service.

Wheelbarrows are now being made from aluminum, which has proved to be an unusually suitable material for this purpose. Aluminum resists the abrasive action of gravel, coal, or similar substances fully as well as sheet iron, and resists corrosive action to a much greater extent. Full-sized wheelbarrows are made from aluminum, weighing only 37 pounds.

EDITORIAL COMMENT

During the past year, MACHINERY has frequently pointed to the need for careful consideration of some obvious defects in our economic system, defects for which sane remedies are needed; but if we understand at all what Technocracy means, which we are not sure that we do, we are quite certain that the remedy does not lie along the road supposedly indicated by the group of men who have coined this much-quoted word.

We feel that our readers will pardon us for not being quite certain as to the conclusions and objects of Technocracy after having read one of the "challenging conclusions" of Technocracy, as stated by the leading proponent of the idea. This quotation, from the *New Outlook*, reads:

Technocracy Twaddle—Loose Talk or Political Propaganda?

"The process of decision arrivation used in a modern power transmission system is without precedent or historical ancestors. The method of arriving at social decisions in a dynamic continent-wide mechanism wherein the element of change intrudes itself into every national rate of flow of goods or services, must be such that the intolerance or precision must be obtained in quantitative units peculiar to the rate which is being measured. It follows that this civilization on the North American continent must be operated on a thermo-dynamically balanced load."

We do not believe that the engineering and economic aspects of Technocracy are to be taken seriously. The statements published in the name of Technocracy have been obscure, misleading, and inaccurate. It is possible, however, that the ultimate purpose of the group sponsoring these new ideas has nothing to do with engineering, but is simply a well designed entering wedge for political propaganda, to be launched as soon as the ground has been properly prepared through present attention-getting methods.

In 1930, the exports from this country to the Soviet Republics exceeded those of Germany and were three times as great as those of England. During the last two years, however, this great trade with Russia has, to a large extent, slipped away from the United States. The total exports for 1932 were only one-tenth of what they were in 1930, while those of our foreign competitors increased. Our machine tool exports fell off to one-sixth of the 1930 volume.

The governments of Great Britain and Germany have done much to assist their manufacturers in obtaining Russian business. They have realized that the Soviet market is one that is likely to grow into important proportions. The Soviet machinery industries have made great strides and are producing vastly more than they did before the war; but the machinery imports into Russia, nevertheless, have continued to increase tremendously. In 1931 they were three times as great as before the war. The increased output within the country has stimulated, instead of reduced, the importation from abroad.

The Russian Market is Too Important to be Neglected

High-class equipment, such as machine tools, will be in great demand for many years to come. Until recently, American manufacturers supplied the greatest portion of the requirements of the Soviet Republics for this class of equipment. Unfortunately, in the last two years, this trade has passed into the hands of foreign competitors to a great extent; but there are no insurmountable obstacles to its recapture.

Our industries successfully emerged from previous depressions because something new was developed, the manufacture of which required industrial expansion; but now, we are told, there is nothing new on the horizon. In the past, there was first extensive railroad building, then the bicycle, the automobile, the radio, and the airplane. What is there now?

Have We Reached the End of Our Industrial Development?

What is there now!!! Have the majority of homes automatic refrigerators, automatic heating, air-conditioning equipment, or even vacuum sweepers? High-speed Diesel-electric railroad equipment has proved successful in Germany; would it not be equally successful here? Twelve years ago the radio was at the same point of development as television is now. How many million television sets will there be in American homes twelve years hence? Are the twenty-four million automobiles used in this country all new and in good condition? How many of them will need to be replaced within the next three years? And how many machine tools are there over twenty years old? The list is far from complete; but—who said "What is there now?"

Torch Hardening of Gear Teeth

The Gear Teeth to be Hardened are Heated by an Oxy-Acetylene Torch and Then Immediately Quenched by Water Jets

By NORMAN E. WOLDMAN, Metallurgical Engineer
Westinghouse Electric & Mfg. Co.

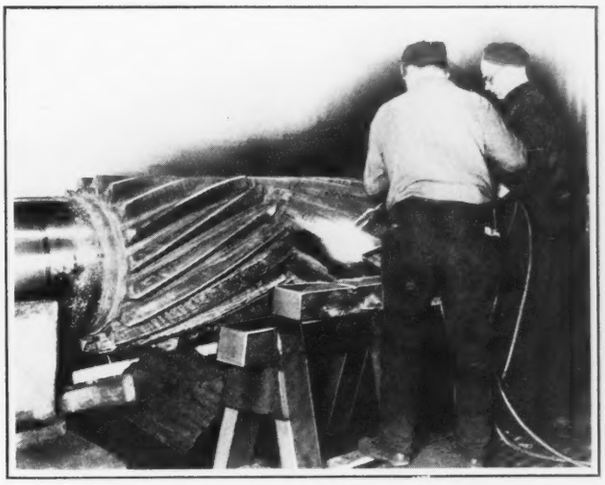


Fig. 1. In Hardening the Teeth of this Large Pinion, Both Sides of Each Tooth are Heated by the Acetylene Torch. A Quenching Jet Immediately Follows the Torch

ONE of the chief requirements of a gear material is that it shall have the proper strength to withstand service loads and to resist shock and impact. It must also perform its duty without a large amount of wear. To meet the demand for increased wear resistance and increased life, heat-treated material has come to the front. By heat-treating plain carbon steel or alloy steel gears, the tensile strength, yield point, elastic limit, and hardness are increased with a greater or smaller sacrifice of ductility, depending upon the material and heat-treatment selected.

Several methods are employed for heat-treating plain carbon or alloy steel gear material. These methods include one form or another of casehardening, water quenching, oil quenching, or air hardening. The more drastic the quenching medium, the harder the material and the greater the distortion. This means that the design of the gear must be carefully studied in selecting the steel and in heat-treating it to obtain the desired physical properties with the minimum distortion.

The Westinghouse-Nuttall gear plant has developed and has been using successfully a new process for the localized heat-treatment of gear teeth without subjecting the gear to the distortion caused by a liquid quench from a high temperature. This process is known to the trade as the Nuttall "E.P." heat-treating process. The gear can be finish-machined to size and then heat-treated by this process with absolutely no distortion of the gear proper and with no distortion (or a negligible amount) of the gear teeth.

Gears and pinions given the "E.P." treatment are made from the finest quality medium-carbon steel purchased under the most rigid specifications for forgings and castings. The steel purchased is carefully analyzed in the laboratory, and coupons are examined under the microscope for cleanliness and

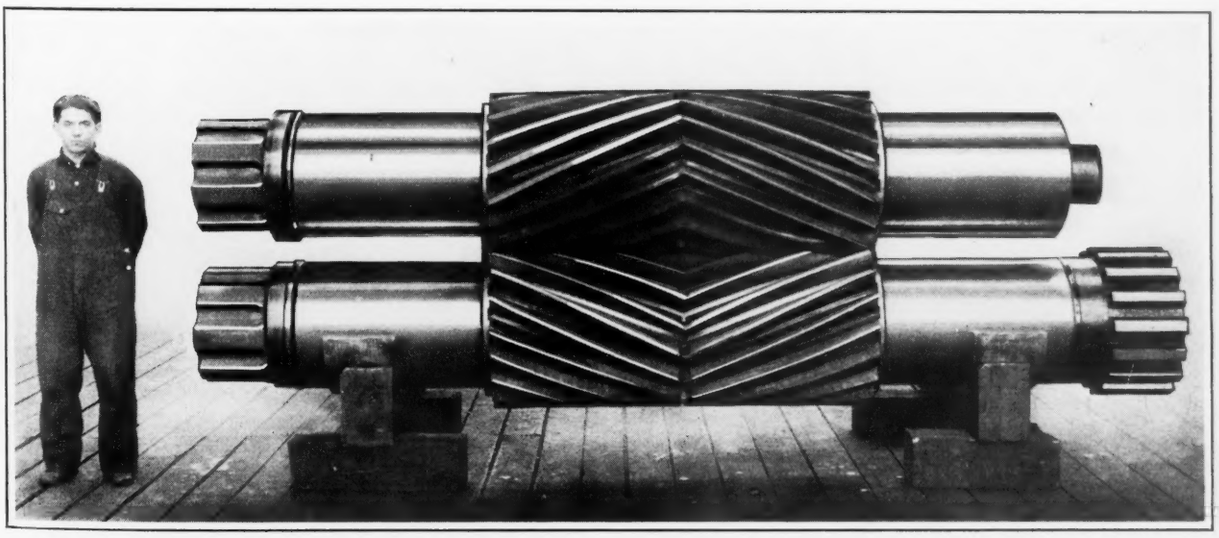


Fig. 2. A Set of Double-helical Pinions, the Teeth of which are Torch Hardened with Practically No Distortion

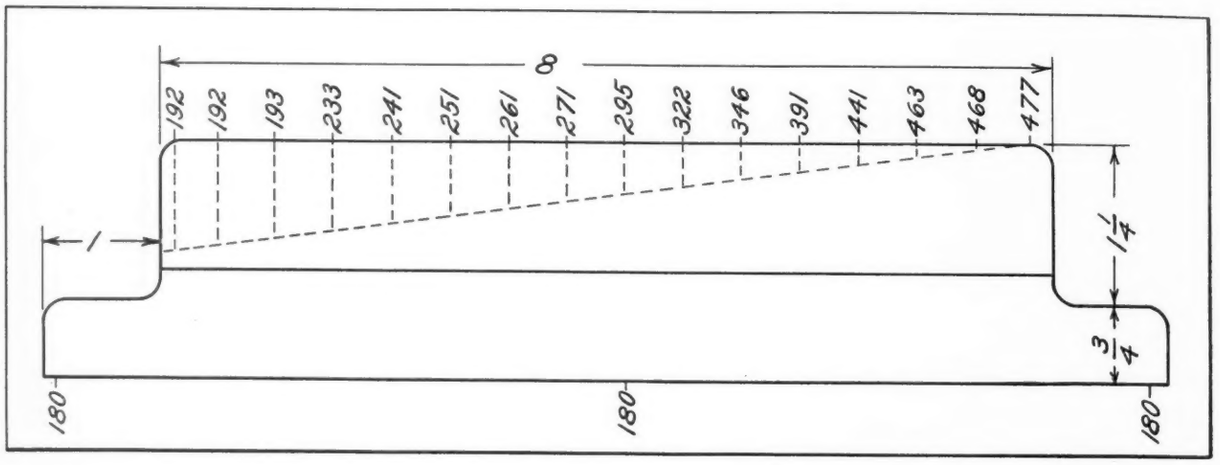


Fig. 3. Diagram of a 2-pitch Tooth, Illustrating a Gradual Decrease in Hardness Toward the Root, as Indicated by the Brinell Hardness Numbers

uniformity of structure before being released for production. The forgings are then normalized and the castings are thoroughly annealed for grain refinement and increased ductility. After finish-machining and cutting of the teeth, the gears and pinions are conveyed to the heat-treating department for hardening the teeth.

The "E.P." process is a localized torch-hardening process requiring trained and skilled heat-treaters familiar with the characteristics of the oxy-acetylene torch and capable of recognizing temperatures by means of heat colors. The hardening is effected by playing the cone of a properly regulated torch flame on the surface or bearing face of each gear tooth. By means of a specially designed double torch (fork type), two flames can be heating the surfaces of both sides of each tooth simultaneously. The gear is set on a jig so that the teeth are either vertical or at an angle. The double flame torch is played over both faces of the whole tooth to preheat them to a temperature near the critical range. Actual heating to the hardening temperature is then begun on both faces at the lower end of the tooth and carried gradually upward in a helical path along the pitch line, the torch being followed by two water jets to quench the heat imparted to the surfaces. The cooling jets follow directly behind the heating flames as they traverse the surfaces of the metal, so that quenching takes place immediately after the steel is brought above the critical temperature.

By this method of heat-treatment, only the working faces of the tooth are heat-treated, while the rest of the gear remains in its natural condition. The working faces are hardened to 450–500 Brinell, producing a hard wear-resisting martensitic structure, while the core retains the high ductility of the original material. After hardening, if size will permit, the gears are given a strain-relieving draw in an oil bath.

Physical Properties of Torch-Hardened Steel Forgings and Castings

Physical Properties	Core (Minimum)	Outer Fibers (⅛ Inch Depth)
Medium-Carbon Forgings (0.4–0.5 Per Cent Carbon)		
Tensile strength (lbs. per sq. inch)	80,000	205,000–255,000
Yield point (lbs. per sq. inch)	42,000	180,000–230,000
Elastic limit (lbs. per sq. inch)	35,000	140,000–170,000
Elongation (per cent)	30	12–7
Reduction of area (per cent)	40	30–20
Brinell hardness	150	415–514
Izod impact	26	8–5
Medium-Carbon Steel Castings (0.35–0.45 Per Cent Carbon)		
Tensile strength (lbs. per sq. inch)	75,000	185,000–235,000
Yield point (lbs. per sq. inch)	35,000	130,000–160,000
Elastic limit (lbs. per sq. inch)	30,000	110,000–135,000
Elongation (per cent)	18	10–6
Reduction of area (per cent)	30	25–15
Brinell hardness	140	375–477
Izod impact	20	6–4
Carbon-Vanadium Steel Forgings (0.4–0.5 Per Cent Carbon, 0.15–0.25 Per Cent Vanadium)		
Tensile strength (lbs. per sq. inch)	82,000	215,000–295,000
Yield point (lbs. per sq. inch)	50,000	195,000–255,000
Elastic limit (lbs. per sq. inch)	48,000	170,000–200,000
Elongation (per cent)	30	20–13
Reduction of area (per cent)	57	50–40
Brinell hardness	156	415–514
Izod impact	30	20–12

Typical Examples of Torch Hardening

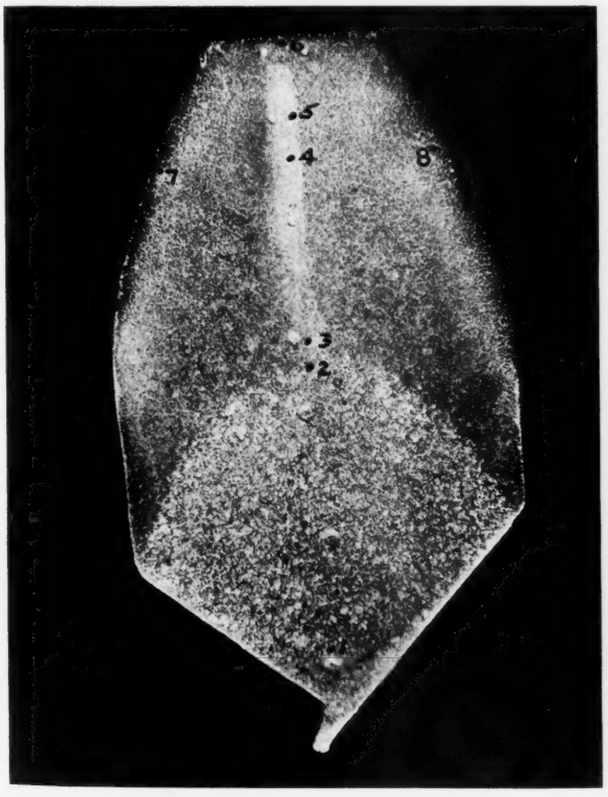
In Fig. 1 is shown the method of hardening a four-high continuous plate mill pinion by this process. Note that one operator is heating each tooth locally with the oxy-acetylene double torch, while the other one is following the torch with

water jets for quenching. In Fig. 2 is shown a set of two of these pinions on the test floor after hardening. These pinions have a pitch diameter of 25 inches, 18 teeth, a 4.3633-inch circular pitch, a 62 3/4-inch face, and double-helical special cut teeth. The top pinion was made from a 0.40 to 0.50 per cent carbon-steel forging, quenched and tempered to 84,000 pounds per square inch tensile strength. The bottom pinion was made from medium carbon-vanadium steel, quenched and tempered to 90,000 pounds per square inch tensile strength. All the teeth and the splines at the mill end of both pinions were torch hardened to 450–500 Brinell. These pinions weighed between 18,000 and 20,000 pounds each.

After being heat-treated, the teeth and splines were scleroscoped for uniformity of hardness. The hardness varied uniformly from 62 to 70 scleroscope. The teeth were then checked for distortion due to heat-treatment, and it was found that the distortion was negligible and within all reasonable limits for machined gear teeth. The two pinions were then run together on the test floor of the customer's plant, after the teeth of the top pinion had been covered with red lead, and true full bearing on all teeth resulted.

The physical properties for steel forgings and castings obtained with the process described are given in the accompanying table.

Fig. 4. Section of the Tooth in Fig. 3 Magnified Four Times. The Dark Portion is the Torch-hardened Zone



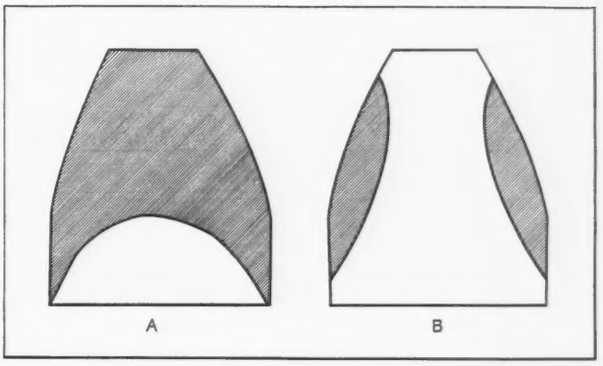


Fig. 5. Diagram Showing at A a Torch-hardened Tooth and at B a Tooth Hardened by Other Local Hardening Processes. Shaded Areas Represent Hardened Zones

A diagram of a 2-pitch tooth from a 17-tooth railway pinion that was taper-ground after "E.P." hardening is shown in Fig. 3. Note that for a taper as shown in an 8-inch length the Brinell hardness decreased from 477 to 192. Also note that the hardness is 250 Brinell at a depth from the tooth top of 5/8 inch. This is evidence of the depth of hardening by this process, showing that the core at the pitch line of the tooth has been sorbitized and partially hardened and strengthened. The core at the tooth root was found to be approximately 175 Brinell, which was about the same as the hardness of the original normalized forging.

The tooth section shown in Fig. 4 is a magnification of four diameters of the tooth represented in Fig. 3. The polished surface was moistened with a nitric acid alcohol solution for differential etching. The darker area shows the zone affected by the heat-treatment. Hardness tests were made at various points on the transverse section, and the following values obtained for the areas numbered from 1 to 8: Point 1, 175 Brinell; point 2, 200 Brinell; point 3, 250 Brinell; point 4, 444 Brinell; point 5, 461 Brinell; point 6, 477 Brinell; point 7, 495 Brinell; and point 8, 477 Brinell.

Fig. 5 shows, diagrammatically, two methods of localized torch hardening of gear teeth. At *A*, the shaded area shows the zones affected by the "E.P." process of heat-treatment, and at *B*, the shaded area shows the zones affected by other processes.

When the "E.P." process is applied to non-water-hardening alloy steels, such as oil-hardening or air-hardening steels, a new quenching medium is substituted for the water. This quenching medium may be wet steam, nitrogen, or forced air. The proper quenching medium is determined by the alloy material and by the tooth size.

Summarized Advantages of Torch Hardening

In the following are listed the many advantages claimed for the torch-hardening process described:

1. Surface hardening of plain carbon steels to 400–500 Brinell, carbon-vanadium steels to 450–550 Brinell, and alloy steels up to 600 Brinell can be accomplished.

2. Surface-hardening can be effected with negligible distortion.

3. Hardening can be localized to any given areas without affecting other parts of the heat-treated member.

4. Depth of hardening is great. This depth is approximately 1/2 inch from a surface hardness of 500 to a depth hardness of 300 Brinell.

5. For large sections, the core is unaffected and will retain the high ductility of the original normalized or annealed structure.

6. This process can be applied to any steel throughout the whole carbon range and also to any alloy steel.

7. The quenching medium can be changed for different alloy steels to suit the conditions.

8. There are no surface checks or quenching cracks.

9. This process is applicable for heavy work that cannot be hardened by dip quenching methods.

10. Parts, if accessible, can be hardened on assembled machines without removal of the parts.

Special Applications of Carbide Tools

In a paper "Current Applications of Cemented-carbide Tooling," read by Roger D. Prosser before the Shop Practice Meeting at the Metal Congress in Buffalo in October, the author referred to several special applications of the new cutting tools.

A Carbide Tool for "Diamond-Boring" Operations

One of the new grades of tool material that is especially hard and is designed for high-speed precision boring operations—so-called "diamond boring"—is known as Widia M-68. This grade is too brittle to be used except for the lightest cuts where the machine runs very smoothly and without vibration. For such operations, however, it gives most satisfactory results.

It was especially pointed out that cemented-carbide tools should not be applied to the machining of steel indiscriminately. "There are still many places," said Mr. Prosser, "where no cemented carbide can be applied with success. However, in many applications where the tool pressures are not excessively high and the machine equipment is in first-class condition, these tools can be used to advantage, permitting greatly increased cutting speeds and longer tool life."

Special Applications for Carbide Tools

In addition to what may be considered the standard grades of tungsten-carbide tools, several grades of Widia have been designed for special purposes—one, for example, for rock drilling. This grade is very hard, and hence, also very brittle.

Among the unusual applications of cemented-carbide materials may be mentioned their use as facing materials for measuring instruments and gages. Woodworking knives tipped with tungsten carbide have also proved very successful. In one case, 130,000 feet of teakwood was cut before dulling. High-speed steel knives required regrinding after having cut only 500 feet. Drills for hard rubber, synthetic plastics, and slate have been tipped to advantage with tungsten carbide. It has also been used for saws. In one case, such a saw cut 12,000 linear feet of rubber flooring between grinds. The carbon-steel saw previously used cut only 50 feet before becoming dull. In another case, a Widia saw was used for four months cutting 275,000 feet of insulated board before becoming dull. Carbon-steel saws had to be ground for every 2000 feet.

* * *

More Uses for Scotch Tape

By CHARLES R. WHITEHOUSE

The writer has read with interest the articles published recently in MACHINERY on different uses for Scotch tape. There are still other uses that may be mentioned: Scotch tape makes a fine electrical insulator, as it will stand a 1600-volt 60-cycle test. It is valuable for repairs as well as new work, especially for motor winding.

Used as a tape for covering transformer or other coils, it is superior to other tape. After dipping the taped coil in air-drying insulating varnish, the paper tape assumes a cloth-like consistency, and does not have the tendency to dry out hard that cotton tape has.

In photographic departments, it is useful for "blocking out" or covering portions of the negative not required to be printed. It can easily be removed without harm to the negative, and is not affected by the photographic chemicals.

It is also valuable in automobile painting, as well as in home, office, or plant painting. In this connection, it can be used as a border line or as a divider between the meeting points of two different colors. After its removal, it leaves no stain or mark. In the shop where the writer is employed, a good supply of this tape is kept on hand for new uses which are continually being found for it.

* * *

Improbability is no proof of impossibility.—*The Shop Review*

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Electric Control that Varies Throw of Crank While Machine is Running

By ANDREW BEUSCH

The mechanism illustrated in Figs. 1 and 2 provides a rapid adjustment of the throw of a crank while the machine is in operation. The crankshaft indicated at *A* serves to impart a reciprocating motion to another member of the machine, and any throw of the crank between zero and the maximum is instantly available.

The crankshaft is mounted on tapered roller bearings in an arc-welded housing. Crankhead *B* is integral with the shaft and carries a sliding block of which the crankpin *C* is an integral part. This block is connected by means of link *D* with the draw-bar *E*, which is free to slide axially in shaft *A*. Sleeve *F* is threaded at its right-hand end and has rack teeth on it that mesh with gear *G* (Fig. 2).

Sleeve *F* is keyed to stationary cap *H* to prevent it from turning, but is free to slide axially in this cap. The worm-wheel nut *J* is a running fit in shaft *A*, and is threaded to fit sleeve *F*. A reversing motor rotates the worm-wheel nut through worm *K*, and thus moves the sleeve *F*, with draw-bar *E*, axially, so that, by means of link *D*, the radial position of the crankpin is changed.

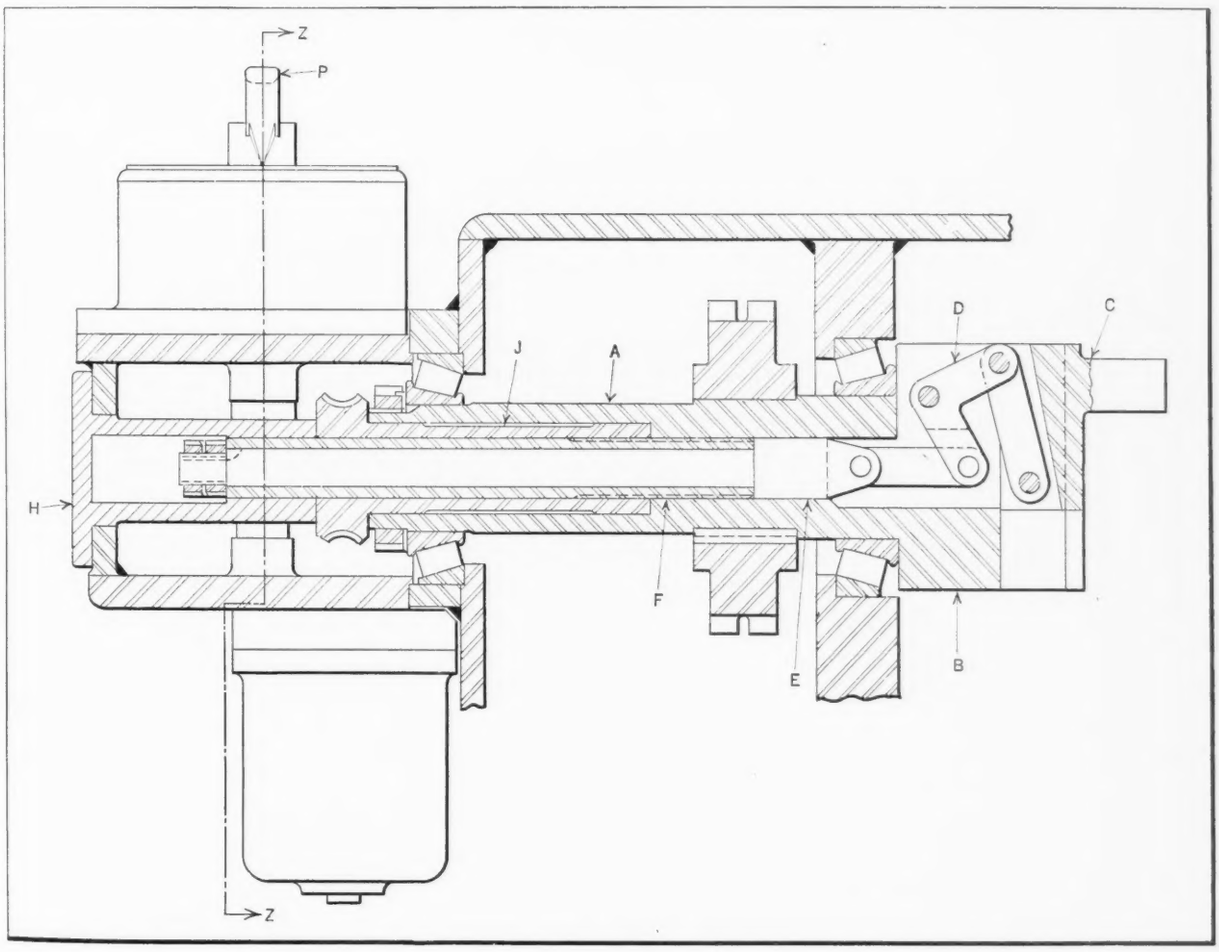


Fig. 1. Motor-driven Mechanism Combined with an Electric Switch for Changing the Radial Position of a Crankpin to Vary the Crank Throw

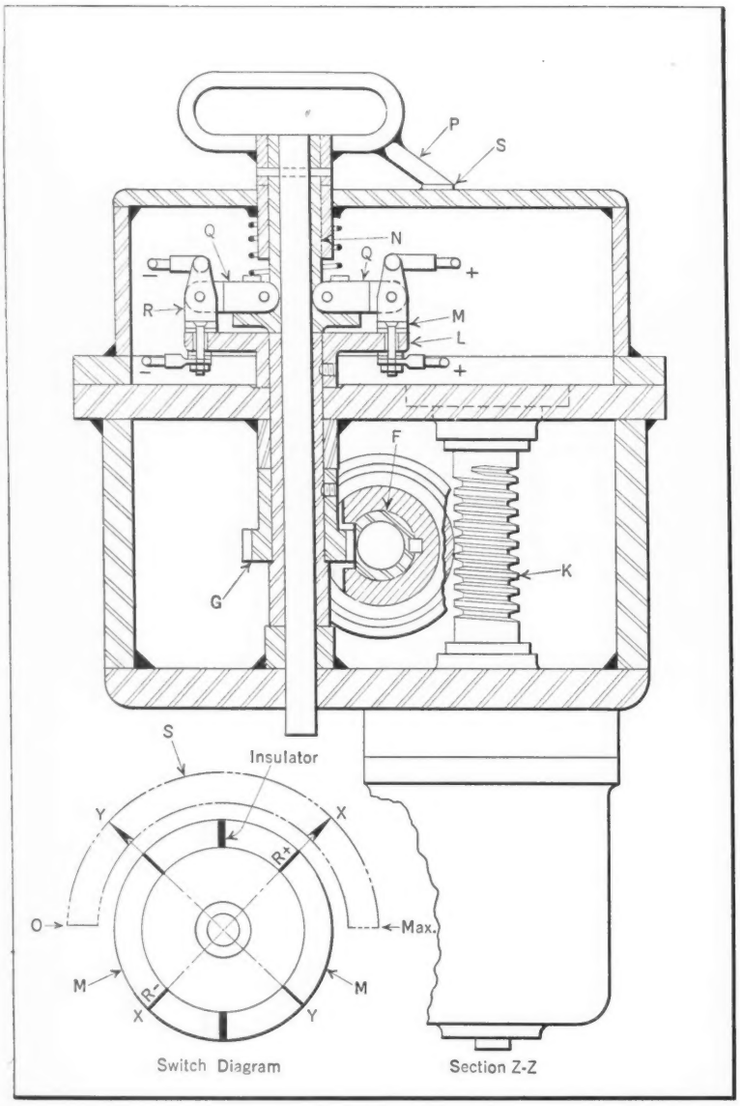


Fig. 2. Section of Mechanism in Fig. 1, Showing the Operation of the Electric Control Switch

The apparatus for controlling the radial movement of the crankpin is shown in Fig. 2. It is contained in a separate housing, and consists of a special electric switch designed to control the reversing motor. This switch has a disk *L*, which is connected by a bushing to gear *G* and is provided with two semicircular contact segments *M*. The segments are insulated from disk *L*. Member *N* is connected to a handle and its pointer *P*.

The links *Q*, hinged to member *N*, are each equipped with a contact blade *R*. The links, with their blades, are held against the contact segments by a coil spring, as indicated. This spring also serves to hold the pointer against the graduated dial *S* and prevents its shifting after an adjustment of the crankpin has been made. To further prevent shifting, the finger is formed like a knife-edge and rests in radial grooves in the dial, which also serve as the graduations.

The operation of the switch will be understood from the switch diagram in Fig. 2. Point $R+$ represents the positive contact blade and $R-$ the negative blade. The contacting segments *M* are connected with the motor and are separated from each other by insulators. When the $R+$ and $R-$ blades are on the insulators, the motor is idle, as the circuit is open, and the throw of the crank is indicated by the position of the finger on the dial *S*. If the finger is moved toward the right, so that the blades $R+$ and $R-$ coincide with line *X–X*, the blade $R+$ is in contact with the right-hand segment and $R-$ with the left-hand segment, and the electric circuit is closed.

Consequently, the motor will start and shift the crankpin, as already explained. In the meantime, through the axial movement of sleeve *F* and the resulting rotation of gear *G*, the disk *L* turns clockwise until the contact blades engage the insulators. At this point the circuit is broken and the motor stops, leaving the crankpin in a radial position corresponding to the position of the pointer on the dial *S*.

If the pointer is moved toward the left, say on line *Y–Y*, the motor will run in the opposite direction and move the crankpin back toward its former position. In this way, to either shorten or lengthen the throw of the crank, the operator merely swings the pointer handle so that the pointer engages the graduation on the dial corresponding to the required throw. This adjustment, besides being rapid, is made with a minimum amount of effort, as the motor does the actual work of shifting the crankpin. In designing the switch, great care should be taken to thoroughly insulate the electrical contacts.

* * *

Remodeling a Friction Clutch to Prevent Over-Running

By ERIC BENGSTON

In remodeling an old slotter into an automatic boring machine, it was necessary to design a clutch that would, when tripped, let the slide with its attached boring head travel downward at a rapid speed to within a short distance of the work, feed through the work at a reduced speed, and then return rapidly to its starting point and stop, thus completing the cycle of operations. The design of the clutch, as first made up, was similar to one illustrated and described in MACHINERY'S Encyclopedia. This clutch is shown in the lower view of the accompanying illustration. It consists primarily of a clutch cam *A* keyed to the camshaft *B*, the friction

rollers *C*, and the driving gear and its outer friction driving hub or clutch ring *D*.

The clutch is controlled by the releasing ring *E* and the stop-pin *F*. When the stop-pin *F* engages ring *E* and stops its rotation, the clutch rollers are thrown out of engagement, thus stopping the shaft *B* instantly.

In testing the machine, it was found that after the clutch had been tripped and had carried the operating cam past its center, the load on that side of the operating cam threw the clutch cam out, thereby allowing the operating camshaft *B* to turn freely and the boring head and spindle to drop suddenly to the end of the stroke. When the operating cam finally came around into a position where the weight of the slide and spindle exerted a pressure on the opposite side of the operating cam, the clutch was again engaged and brought the spindle back to its upper position. In order to overcome this objectionable feature, a new clutch cam was made, as shown in the enlarged view at *G*.

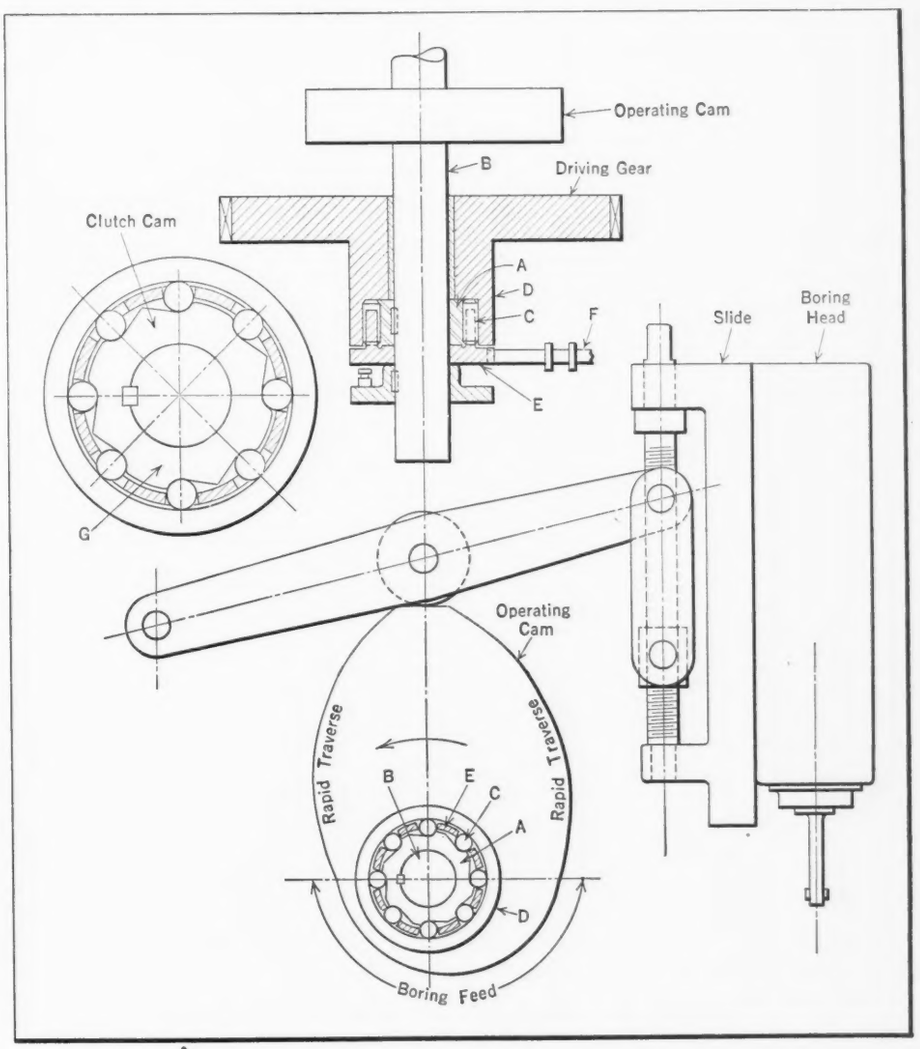
With the new clutch cam *G*, every second angular roller contact face was reversed so that it would grip the clutch ring when turned in the opposite direction. In order to eliminate any possible backlash and thus prevent any drop of the spindle when the gripping action changed from one set of rollers to the other, the rollers on the reversed faces were made to fit snugly between the clutch ring and the clutch cam. This modification has worked out very satisfactorily.

On a clutch of the design described, in which the motion is very slow—only one revolution per minute—the angular faces on which the rollers are wedged should be steep enough to give the rollers sufficient space to fall free from the clutch ring in the released position, in order to eliminate a very objectionable drag, which might otherwise develop. For higher speeds, where the release ring is carried back to its released position by the momentum of the moving parts, the drag on the clutch is entirely eliminated, even though the angles of the angular roller contact faces are rather small.

Composition of Steel Used in Drills for Wood

In a paper read before the American Society of Mechanical Engineers, at Buffalo, N. Y., J. V. Emmons, metallurgist of the Cleveland Twist Drill Co., referring to drills for wood, mentioned that in these drills a moderate degree of hardness and a high degree of toughness are essential. The material chosen for drills to be used for this purpose, therefore, is generally carbon steel, but three different kinds of steels should be used. Small drills of simple design are made from ordinary carbon steel; for larger, more massive drills, a 0.50 per cent chromium steel is recommended; and for drills of special design with projecting parts, where there is danger of fire cracks in the hardening operation, a 1.20 per cent chromium steel, which can be oil-hardened, is preferred.

For drilling machine steel, where a higher degree of hardness is required than for drilling wood, the standard "18-4-1" high-speed steel is generally used, and is the steel recommended by tool manufacturers for that purpose.



Cam-operated Boring Head with Special Friction Clutch Drive

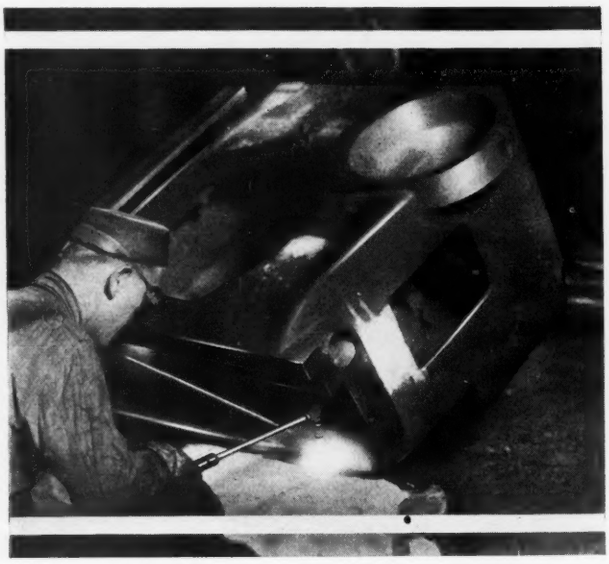
Advances Made in the Field of Gas Welding and Cutting

Equipping for the New Needs of Industry
Section 18

THE process of gas welding is so well established and so much has been published on this subject that little need be said about present applications. Some interesting equipment has recently been devised, however, and in some directions the methods used in the oxy-acetylene welding process have shown a marked improvement. For example, a process has been devised which is the result of years of laboratory research and field testing. It depends essentially on a new method of blowpipe manipulation and the use of a new welding rod. It is stated that in welding pipe for oil and gas lines, the new process has saved from 30 to 60 per cent of the time required to make the welds by methods previously employed and that the oxygen and acetylene consumption has been considerably reduced. At the same time, consistently strong welds have been obtained. More than 300 miles of high-pressure pipe lines have been welded by this process.

An oxy-acetylene, two-flame welding blowpipe having a welding rod holder that automatically feeds the rod by gravity simplifies many welding operations. Two separate flames are used—one for preheating the welding rod and the other for fusing the base metal and for melting the end of the preheated rod. In operation, the blowpipe is supported by a carriage having two adjustable runners, so that the operator need use only one hand to hold the blowpipe.

Automatic oxy-acetylene cutting machines have become an important part of the production equipment in many plants in the machine-building industry. Billets, steel plates, and structural shapes are automatically cut to almost any desired form.



Remedying Surface Defects in a Heavy Casting by Oxy-acetylene Welding (Courtesy of Linde Air Products Co.)

Often the pieces can be cut so accurately that no further machining is required. Even when additional machining is necessary or desirable, the work can be cut so close to dimensions by the recently improved machines that only a small amount of machining is required.

These machines form an important part in the process of building up machine frames and beds from plate and structural shapes, because the cutting up of plates and shapes to the required size is generally a preliminary to welding. The automatic shape-cutting machine speeds up production, lowers cost, and is an important aid in the fabrication of equipment.

The cutting of metal parts having irregular or intricate shapes, such as dies, stripper plates, cams, and jig plates, is greatly facilitated by a gas cutting machine recently developed. This machine is intended primarily for tool-room use. The cutting flame is guided by templets or directly from a "true-scale" drawing. The machine can be operated by hand, automatically, or semi-automatically.

Metal of any thickness from 1/4 inch to 8 inches can be cut at speeds of from 3 to 12 inches per minute. For example, steel 1 inch thick can be cut at the rate of 12 inches per minute. Smooth cuts and sharp edges are obtained, so that only 1/16 inch of stock need be allowed for machining.

As an example of what can be accomplished with the cutting torch, the demolishing of a 55-ton cast-steel block may be mentioned. It was impossible to dispose of this huge casting in one piece, but by cutting it into sixteen parts, it was handled conveniently.

The cutting of steel by the oxy-acetylene process is well known, but recently rapid progress has been made in cutting cast iron effectively by this means. In the case of steel, the cutting torch has proved itself an economical tool for an almost unlimited

Solving a Manufacturing Difficulty by Welding Cold-rolled Steel Strip for Megaphone Rims (Courtesy of Linde Air Products Co.)

number of applications in fabricating, manufacturing, and demolishing work. The oxy-acetylene cutting of cast iron, however, appears to be limited at the present time to the making of alterations in and repairs to machinery, and to the demolishing of large castings. The most extensive application of cast-iron cutting at present is probably in the repairs of cracks or breaks in large cast-iron members, which have to be prepared for the welding process by "veeing."

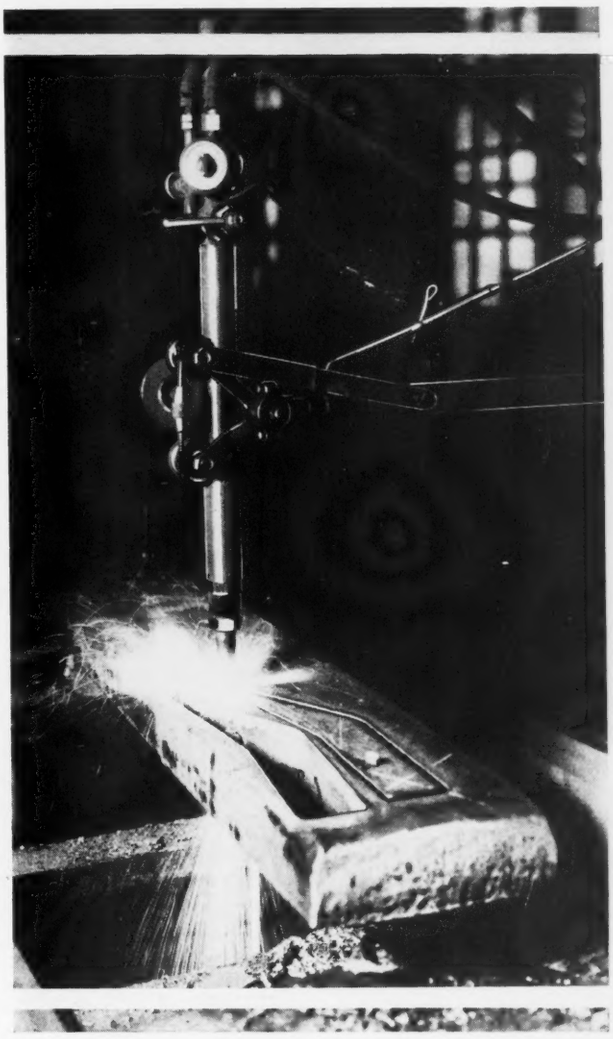
The cost of making a cut in cast iron is considerably higher than the cost of making a similar cut in steel, but there are instances when the cutting torch provides the only method of demolishing castings, unless sawing or drilling operations are employed, and these are generally slow and expensive.

The Use of Welding in Hard-Facing

Great strides have been made in the process of hard-facing, Stellite being one of the most generally used materials for this purpose. The hard-facing material may be applied either by the oxy-acetylene or the electric-arc process to a surface that is ordinarily subjected to rapid wear. Exhaustive studies and long-time tests have demonstrated clearly the economy of hard-facing.

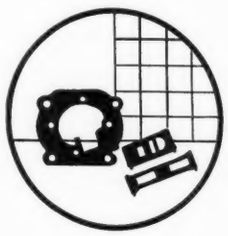
As a result, the practice of covering parts exposed to abrasion with a layer of wear-resisting alloy has been accepted as standard procedure in many fields. The life of punches and dies can be greatly increased by this means. Dies that previously would have been scrapped may now be salvaged, built up, and hard-faced, and then returned for use. In fact, even better results are obtained with salvaged dies than with new ones. In one automobile factory, hot-trimming dies for ring-gear forgings for trucks proved, after hard-facing, to have a life eight times that of former dies, and steering-arm hot-trimming dies lasted three times as long.

The wear on machine parts can also be reduced by hard-facing. Shear blades constitute another excellent example of the value of hard-facing. Cam surfaces can be hard-faced to advantage to resist the constant wear of the cam roller. In an automobile parts plant, cam life was increased in this manner as much as eight times.



Cutting out Heavy Machine Frame Parts with the Oxy-acetylene Machine Cutting Blowpipe (Courtesy of Linde Air Products Co.)

Field for Non-Ferrous Metals is Broadened by Active Research



Equipping for the New Needs of Industry
Section 19

MANY of the important achievements of the mechanical industry during recent years can be attributed in a large measure to the untiring efforts exerted in the development of non-ferrous metals and alloys. These efforts have been richly rewarded by the production of many new and valuable alloys, improvements in the older alloys, and innumerable new applications which have resulted in marked economies in practically all manufacturing branches. Many of the improvements resulting in wider applications of these alloys have been obtained merely by applying different methods of heat-treatment, the composition remaining the same. However, new alloy compositions play a large part in the recent developments.

New Heat-Treating Methods Have Made it Possible to Use Non-Ferrous Metals as Substitutes for Steel

The non-ferrous metals — copper, lead, zinc, nickel, aluminum, and tin—have been the subjects of a great deal of research. In corrosion-resisting qualities and electrical properties, these metals are in many respects superior to steel, but because of their lower mechanical strength and hardness, they have not always been suitable substitutes.

Recently, however, it has been found possible to improve their mechanical properties by heat-treatment; alloys made from these metals, when properly treated, can be greatly increased in both hardness and strength. Copper, for example, can be hardened to about 400 Brinell, and copper-nickel alloys can be heat-treated so that tensile strengths in the neighborhood of 175,000 pounds per square inch can be obtained.

After certain heat-treatments, these alloys will "age-harden." Sometimes they age-harden at room temperature; sometimes they must be aged at higher temperatures. A single day is often adequate to bring about the desired changes in mechanical properties.

In few branches of the mechanical industries has progress been as rapid as in the development and use of light-weight alloys, primarily magnesium alloys. These have a specific gravity of less than one-fourth that of steel. Their unusual qualities have gained recognition so rapidly that, in a normal year, the consumption of magnesium reaches nearly a million pounds.

Magnesium alloys, because of their lightness, combined with strength and toughness, are particularly well adapted for use in portable hand-operated equipment, as well as in high-speed reciprocating parts of machinery, and in the automotive and aircraft industries. They have been used successfully for propellers and blades of high-speed fans, and should be considered wherever inertia and centrifugal forces are to be dealt with.

At least ten of the twelve leading manufacturers of aviation engines in this country are using magnesium-alloy parts. Cast magnesium alloys are made having a tensile strength, when heat-treated, up to 38,000 pounds per square inch and a compressive strength up to 51,000 pounds per square inch. Wrought magnesium alloys are made having tensile strengths up to 48,000 pounds per square inch and compressive strengths up to 65,000 pounds per square inch.

Magnesium alloys can be welded either by the acetylene or the electric spot- or seam-welding process. Several commercial aluminum welding fluxes have been developed, composed essentially of sodium, potassium, and lithium chlorides. Acetylene welds on magnesium-alloy sheets can be made that will have a tensile strength of from 25,000 to 30,000 pounds per square inch. Satisfactory electric spot-welds have been made on sheets up to 1/4 inch thick.

The magnesium alloys are all easily machined. Both the speed and the depth of cut can be materially greater than those employed in usual shop practice with other metals. Light finishing cuts will provide a smooth surface that can be held to very exact dimensions.

New Developments in the Uses of Aluminum and its Alloys

Aluminum alloys also play an important part in light-weight construction. Overhead traveling cranes have been constructed almost entirely from this material. The bridges and trolleys of these cranes are made from aluminum-alloy rolled structural sections and aluminum-alloy castings. The net weight of a 10-ton crane with a span of 76 feet 6 inches between the truck wheels is 30,000 pounds; if constructed from steel, it would weigh approximately 77,000 pounds.

The aluminum alloy known as "Lo-Ex" (which signifies low expansion) constitutes an outstanding improvement in automobile piston materials. This alloy, which contains approximately 14 per cent silicon, with varying amounts of nickel, copper, and magnesium, has a lower coefficient of expansion, better thermal conductivity, and better bearing qualities than other aluminum alloys. Its specific gravity is less than that of the aluminum-copper alloys and about equal to that of pure aluminum. Some difficulties have been experienced in machining this alloy; but through the application of tungsten-carbide tools, the machining problems have been solved.

There are three methods of making castings from aluminum and other alloys in present practice—sand casting, permanent mold casting, and die-casting. With the permanent mold method, a somewhat wider range of alloys can be used than with the die-casting method, because, in the former case, the hot metal is poured by gravity, whereas in the latter case, it is forced into the dies under pressure. For this reason, die-casting is practically limited to alloys with melting points ranging up to about 1400 degrees F.

Aluminum Sheets and Aluminum Alloys Have been Made Use of to Greatly Lighten the Weight of this Interurban Car, Capable of a Speed of 80 Miles an Hour (Courtesy of Aluminum Co. of America)

The alloys most generally used with the die-casting method are those having either aluminum, zinc, tin, or lead bases. With the permanent mold method, the molds withstand much higher temperatures, and metals such as copper and brass, which melt in the neighborhood of 2000 degrees F., can be handled. When a large number of parts is required, either the permanent mold or the die-casting method is generally used for the metals mentioned. There are, however, comparatively few concerns that use the permanent mold method.

Castings having a wide range of physical properties are made in permanent molds. Aluminum alloys are most widely used. Aluminum, with small percentages of copper, silicon, iron, magnesium, or tin, produces castings with tensile strengths of from 18,000 to 30,000 pounds per square inch, and up to 10 per cent elongation in 2 inches. By heat-treatment, the tensile strength of these castings may be increased to from 24,000 to 55,000 pounds per square inch. The composition of the alloy, of course, determines the physical properties in each case. The permanent molds used are made from semi-steel castings.

Copper-Base Alloys of Great Strength

A copper - silicon - manganese alloy known as "Everdur" is suitable for use in place of steel when the metal is exposed to corrosion. The alloy has great strength, good machining qualities, and resists many corroding agents. It is used for non-rusting bolts and similar accessories, for lag and wood screws, U-bolts, pipe, and tubing. It is also made in sheets and can be employed for all kinds of drawn shapes, as well as in the form of castings. It can be welded by either the oxy-acetylene or electric-arc process, as well as seam- and spot - welded on automatic welding machines. The welded joints have a tensile strength of approximately 50,000 pounds per square inch.

Cold-drawn rods of Everdur have a tensile strength of from 70,000 to 100,000 pounds per square inch, according to the diameter of the rod, and soft rods have a strength of about 55,000 pounds per square inch. In the form of sheets and tubes, the strength may vary from 52,000 to 100,000 pounds per square inch, according to the treatment to which the metal has been subjected and the size. In the form of wire, tensile strengths upward of 140,000 pounds per square inch can be obtained.

Nickel Plays an Important Part in Alloys

The nickel consumed in the automotive field represents an appreciable percentage of all the nickel produced. Besides being used in alloy steels, in cast iron, and for plating, nickel is used for spark-plug wire, resistance wire, some grades of stainless steel, heat-resisting alloys for valves, and as an ingredient of nickel-silver. Nickel is also present in some of the aluminum alloys used in pistons, such as Y-alloy and Lo-Ex. Nickel-aluminum bronze is also used for valve seats.

Incidentally, the use of nickel cast-iron dies for

drawing sheet-metal parts has proved an effective means for increasing the life of such dies and for improving the finish of the parts produced. Nickel steel is also used in many drop-forge die-blocks.

A New Alloy for Electrical Purposes is Stronger than Steel at Red Heat

A new alloy known as Konel, consisting mainly of nickel and cobalt, has proved to be not only equal, but superior, to platinum for use in radio tubes, as well as for other electric applications where platinum was formerly used. Not only does the new alloy have the remarkable resistance to acids and corrosion possessed by platinum, but it has remarkable strength at red heat and better electric qualities. In fact, if a Konel wire and a steel wire of the same diameter are heated to a red heat, the hot Konel wire will be found to be able to support a greater load than the steel wire.

The Strength of Monel Metal Has Been Substantially Increased

As a result of recent developments in the forging of Monel metal rods and shafts of large diameters at the plant of the International Nickel Co., Inc., at Huntington, W. Va., it has been found possible to further increase the range of physical properties of this metal. A uniform ultimate tensile strength of over 90,000 pounds per square inch and a yield point of over 70,000 pounds per square inch is obtainable in forged bars from 3 to 6 inches in diameter. The elongation averages about 25 per cent in 2 inches. Such properties, for example, are obtainable in propeller shafts 6 inches in diameter and 14 feet long.

Non-Shrinking Alloy Lowers Cost of Die Construction and Maintenance

An alloy, known as "Matrix" alloy, for mounting dies and punches in their holders, is finding more and more general application. The alloy consists of bismuth, lead, tin, and antimony. It has a low melting temperature and is a hard-setting, non-shrinking material. It has opened to the die and tool designer a new field that enables him to save time and labor to a remarkable degree in the construction of many types of dies. In some cases, it also makes it practicable to construct dies that otherwise would be prohibitive from the point of view of economy.

The alloy can be applied both to small, delicate and to very heavy dies. One of the prime factors favoring the use of this material is that while the alloy holds each piece permanently and firmly in place, any piece can be immediately and easily loosened and removed, if necessary, by the application of a little localized heat.

The chief benefit to be derived from the use of the alloy is the elimination of complicated holding devices, such as punches with heels and punch-plates. This alloy also introduces a quick and accurate method of locating punches in relation to dies.

A New Babbitt Has Increased Bearing Capacity

A new babbitt metal is now produced by what is known as the "Thermo-lectric" process. Some of the outstanding advantages claimed for this metal are as follows: The coefficient of friction and the ratio of wear are exceptionally low. The babbitt will carry greater loads at higher speeds with less wear, because of uniformity of structure and an exceptionally smooth surface. A close bond is formed between the shell and the babbitt lining, because there is practically no shrinkage. It will not wipe or damage the shaft and has unusually free running qualities that make for clean pouring.

This babbitt is made in two grades—one, known as "nickel babbitt," contains 90 per cent tin and is recommended where high speed and heavy duty are encountered; the other, called "copper-hardened" babbitt gives very satisfactory service in all applications not requiring the qualities of the nickel babbitt.

Brazing Alloy which Produces Joints in Copper Having a Tensile Strength of 33,000 Pounds per Square Inch

A brazing alloy known by the trade name "Sil-Fos," with a low melting point, makes it possible to obtain unusually strong, sound, corrosion-resistant joints on copper, brass, bronze, nickel, nickel-silver, Monel metal and other non-ferrous metals and alloys. Among the features of special advantage of this alloy are its low melting point—1300 degrees F.; its great fluidity, which makes it able to penetrate all parts of the joint and to alloy with the adjacent metal rapidly; and its self-fluxing characteristics. Copper-to-copper lap joints made with this brazing alloy have shown an average tensile strength of 33,000 pounds per square inch, with an elongation of 17.2 per cent in 2 inches. The alloy can also be used for filling holes in brass castings.

* * *

Value of Machinery Built in 1931

The total value of the products manufactured in the machinery industries in 1931, according to the Bureau of the Census, was $2,860,600,000. Of this, motor vehicles accounted for $1,380,000,000; refrigerating machinery, $157,000,000; steam and internal-combustion engines, $147,000,000; electrical machinery, $137,000,000; pumps and pumping equipment, $75,000,000; textile machinery, $61,000,000; dredging, excavating, and road-building machinery, $57,000,000; machine tools, $56,000,000; agricultural machinery, $50,000,000; washing and ironing machines, $47,000,000; metal-working machinery other than machine tools, $36,000,000; and printers' machinery, $32,000,000.

Non-Metallic Materials Find Application in Machine Design

Equipping for the New Needs of Industry
Section 20

IT is only recently that extensive use has been made of certain non-metallic materials in the construction of machines. The many successful applications, however, dispel any doubt as to the practicability of using these materials for this purpose. Compositions such as Bakelite and Durez are now used as substitutes for metal parts and have been found to be superior to metal in many cases. Other non-metallic materials are used to increase the smooth and quiet operation of machines.

Rubber Mountings have Substantially Reduced Shock and Vibration

New developments in the application of rubber have opened up a broad field for this material in machine construction. Rubber mountings are now widely used to absorb vibration in equipment of a most varied character, ranging all the way from radio sets to heavy air compressors and Diesel-electric units. Shock- and vibration-absorbing mountings are made in the form of either tubular or flat members.

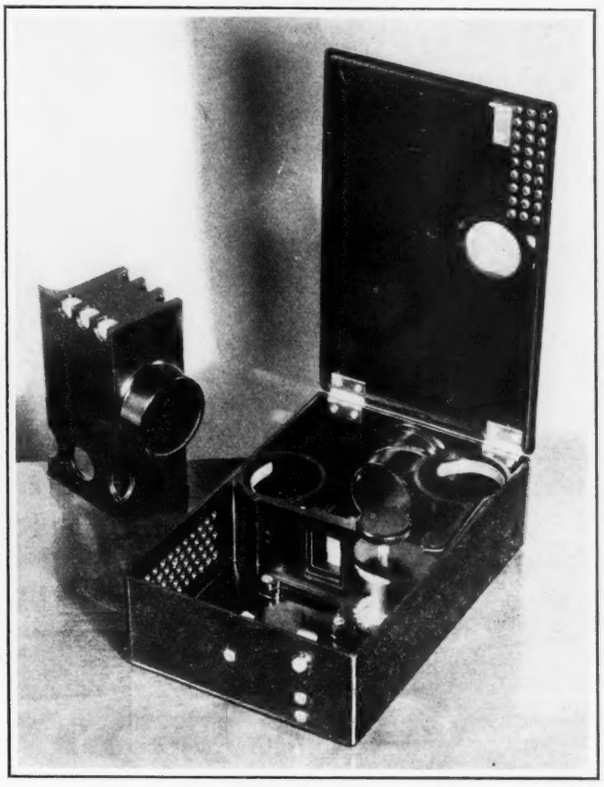
The tubular members are constructed of an outer steel bushing and an inner steel bushing, or solid pin, with rubber between. The rubber is vulcanized directly to the metal parts so that it is integral with them. The flat shock- and vibration-absorbing mountings consist of two plates, with rubber between, vulcanized directly to the plates. These mountings can be so designed that the parts carried by them can move quite freely for a limited distance, after which the mountings "stiffen up," so that they respond only to comparatively heavy loads or vibrations.

The application of rubber mountings is constantly broadening. Most of the automobile manufacturers now use mountings of this kind for supporting the engines, and also for spring-shackle joints, radiator and muffler supports, and body supports on buses and trucks. On airplanes, delicate instruments are mounted on rubber bearings to save them from destructive shocks when landing.

A product resembling soft rubber, known by the trade name "Keldur," has also been developed for absorbing vibrations in machinery. It is not affected by oil and is suitable for use at ordinary atmospheric temperatures, although it is not intended for use at temperatures above 140 degrees F. It is somewhat affected by long exposure to water and is not recommended for use without protection in places where it is kept wet most of the time.

A moisture-proof gasket material, highly resistant to oil, is recommended for applications where the primary purpose of the gasket is to exclude moisture. For this purpose the new material is said to be superior to cork. This material is a white, odorless, sulphur-free rubber compound, available both in sheets and molded shapes.

The solution of many problems in machine design has been found in the use of synthetic plastic materials, such as Bakelite and Durez, of which there are several hundred varieties. Their varying physical properties meet the requirements of a wide range of mechanical applications, including silent-running fans and



A Projection Camera Molded from Durez by the Norton Laboratories, Inc. (Courtesy of General Plastics, Inc.)

intricate machine parts. These materials are obtainable in either powder or sheet form, depending upon the use for which they are intended. One of their outstanding characteristics is that a chemical reaction takes place when heat is applied in the molding process, which hardens the material and prevents it from again being softened by heat.

These materials are now of importance in the fabrication of gears and pinions for many purposes. Recent applications indicate that they are likely to assume an important place in actual machine construction. For example, they are used for the lighter types of machine bases and for fans. The parts are molded accurately to the desired dimensions and require no machining. Finished metal inserts can be molded in place.

Among the many advantages claimed for these materials is their unusual strength, which ranges up to 24,000 pounds per square inch in tension and up to 43,000 pounds per square inch in compression. Their maximum Brinell hardness is 40. They are impervious to steam, oils, and solvents. Mechanical noises from running parts made from these materials are reduced.

The demand for synthetic plastic articles is so great that automatic machines are now in use for obtaining continuous production. In one machine of this type, small disks 1/4 inch in diameter by 0.010 inch thick are formed from powder at the rate of 400 a minute. The disks are then transferred to the baking oven by means of a suction tube.

Parts of a Valve Used in the Oil Industry in which the Entire Valve Chamber, as well as the Ball Valve Itself, is Made from Bakelite (Courtesy of Bakelite Corporation)

"Plaskon" is a new plastic molding material from which objects may be made in different colors with a hard lustrous surface. The specific gravity of this material is 1.43, the tensile strength from 4000 to 6000 pounds per square inch, and the compressive strength from 25,000 to 30,000 pounds per square inch. It is unaffected by alcohol, acetone, oil, or other common solvents. It has a scleroscope hardness of from 80 to 95. This material can be machined and polished.

* * *

The number of automobiles exported from the United States in 1932 was 182,000, accounting for 13 per cent of the production.

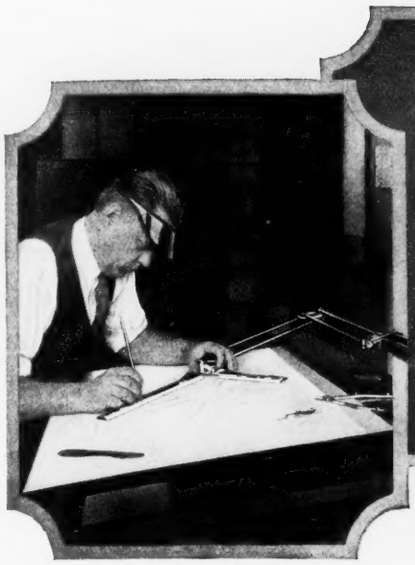
Zinc- and Copper-Coated Steel

Non-ferrous coatings applied to flat rolled steel by the "hot dip" method have been in use for a great many years. It has been known for some time, however, that coatings of the same non-ferrous metals, when electroplated on the steel, are less brittle, more uniform in thickness, and less porous in character. This is particularly true of zinc-plated steel, which can be rolled into difficult shapes (such as are used for automobile drip moldings, window-screen frames, and base-board moldings) and which can be used for deep stampings, such as automobile hub caps. These can be formed without peeling or cracking of the plated coating. The zinc plating not only provides rust resistance, but also makes it easier to draw deep shapes.

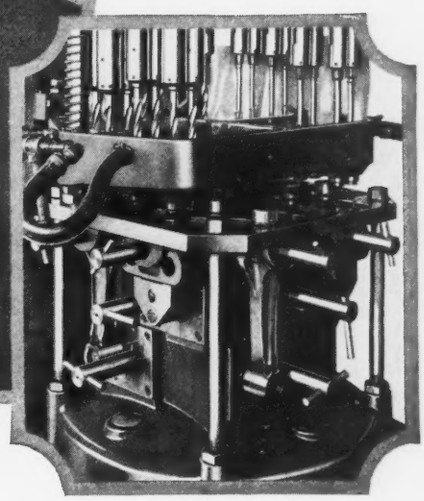
What has been said in the preceding paragraph is equally applicable to copper-coated steel, which, however, is less resistant to rust than zinc. Copper-coated steel is generally used when it is desired to eliminate a plating operation after stamping and forming a part from the steel. The parts so made are either used in their natural finish or the copper coating may form a base for further plating operations. The copper coating also aids in soldering, and in certain instances is specified when a base is required for tinning, after various parts stamped from copper-coated steel have been assembled into a unit.

Another advantage of plated steel is that it may be obtained in long coils which may be fed into a punch press or forming device continuously. This has made these plated steels very popular; and where drawing quality, smooth surface, good finish, uniform thickness, and high production are of importance, plated steels in coils are more and more gaining ground.

The Thomas Steel Co., Warren, Ohio, a manufacturer specializing in the making of zinc-plated steel and copper-coated steel, is now preparing to manufacture a tin-plated strip steel. This product, it is expected, will not only be adaptable to the many uses for which tin-coated objects are now in demand, but will also open up new possibilities where uniform coating and special tempers are of importance.



Design of Tools and Fixtures



Interchangeable Quenching Die for Ring Gears Which Prevents Distortion

By D. L. BROWN, Summit, N. J.

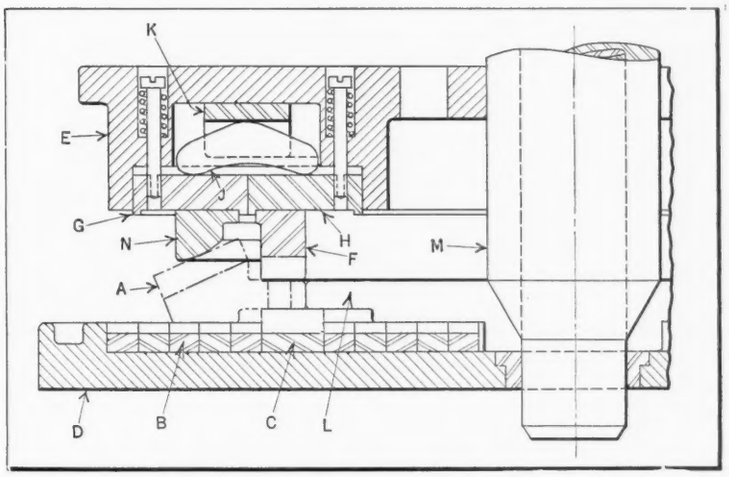
Bevel ring gears are quenched in a commercial type of quenching machine employing holding dies for preventing the gears from warping during the operation. However, owing to the difference in thickness at the tooth and web sections, unequal expansion and contraction take place, and when rigid dies are employed, difficulty is often experienced in obtaining an equal clamping pressure at the various holding points. As a result, the gears are warped or dished after being quenched.

To prevent this, the die shown in the illustration was built. This die has an equalizing arrangement, by means of which the clamping pressure remains constant at the different holding points, whether the gear is hot or cold. Moreover, by the use of interchangeable clamping and supporting rings, gears of various shapes and sizes can be quenched.

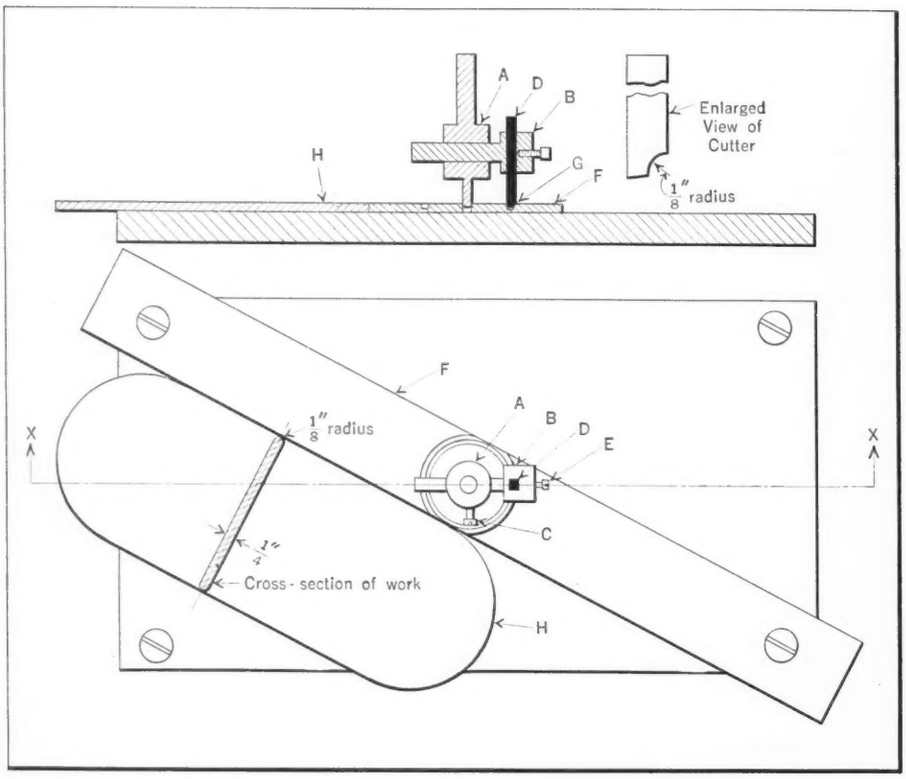
The ring gear to be quenched is indicated at *A*. It is supported on the narrow rings *B* and the interchangeable ring *C*. The top surfaces of these rings are slotted radially to allow the oil to circulate around the gear, and the rings are a slip fit within one another. Thus, by rotating them to various positions, the oil circulation may be increased or decreased as desired. Any of the smaller rings may be replaced by other rings for supporting gears of different shapes and sizes. These rings are mounted and centralized in the lower die member *D*, which is secured to the top of the lower vertical quenching plunger of the machine. Above this plunger is located another vertical plunger, on the bottom end of which is secured the upper die member *E*. On this member is mounted the equalizing arrangement to which the two interchangeable clamping rings *N* and *F* are fastened.

The equalizing arrangement consists of the floating rings *G* and *H*, which are held against the rockers *J* by the coil springs and screws shown. The rockers are confined in radial slots, equally spaced around the retaining ring *K*, which is secured to the member *E*. The gear is centralized on member *D* by the segments *L*. These segments are expanded against the bore of the gear by the tapered cone *M*, attached to the piston of an air cylinder operating independently of the two machine plungers.

In quenching, the gear is placed on the rings *B* and *C*, as shown. As die member *E* descends with the upper machine plunger, the cone *M* expands the segments *L* and centralizes the gear. Sufficient pressure is imparted by these segments against the gear bore to prevent distortion of the bore while cool-



Interchangeable Quenching Die for Ring Gears in which an Equalizing Clamping Arrangement Prevents Distortion of the Gears



Simple Drill Press Set-up for Rounding Edges of Condenser Plates

ing. As the gear contracts at the time of quenching, the segments are forced inward raising the cone without changing the pressure of the segments against the bore. This pressure may be regulated by controlling the air pressure in the cylinder operating the cone. As the upper machine plunger continues its descent, clamping rings *N* and *F* come in contact with the gear with an equal pressure.

Both machine plungers, with the die members and gear now move downward together, immersing the gear in the quenching bath in the base of the machine. The gear is held in the bath until quenched thoroughly, after which it is returned to the position indicated, when the upper plunger raises die member *E* to permit the removal of the gear.

The clamping surface of ring *N* is curved, so that one set of interchangeable rings can be used for gears with slightly varying pitch cone angles. Oil circulates through radial slots provided in ring *F* and through the tooth spaces past ring *N*. Any tendency of the gear to warp may be counteracted by shimming up the supporting or clamping rings.

Simple Edge-Rounding Fixture for Flat Metal Plates

By W. E. STEWART, Sewaren, N. J.

A simple drill press fixture and the radius-forming cutter shown in the accompanying illustration were used recently in a small job shop for rounding the edges of oval-shaped condenser plates, such as shown at *H*. These plates were 16 3/4 inches long and were machined from 1/4-inch aluminum sheet. It was important that the edges be cut to an accurate 1/8-inch radius, as indicated in the cross-section view.

The fly cutter consists of a shaft *A*; an extension *B*, held in place by a set-screw *C*; and a formed cutter *D*, held in place by a set-screw *E*. The cutter was ground with a 1/8-inch radius on the cutting edge, as shown by the enlarged view. A 1/4- by 3-inch steel guide *F* was fastened to the bedplate of the drill press by screws that passed into the tapped holes that were normally used to hold the bedplate to the base.

The fly cutter was adjusted so that the outermost cutting point *G* was 1 5/8 inches from the center of the shaft *A*. A groove was then cut in the guide plate to a depth slightly greater than 1/8 inch. The aluminum condenser plates *H*, which had previously been sawed and filed to the oval shape, were fed along the guide and rotated by hand until the radius cuts on their upper edges were complete.

A stop on the down feed of the drill press prevented the cut from being made too deep. When the upper cut was finished, the plates were turned over and the semicircular shape completed by a similar cut from the opposite side. The fly cutter was revolved at normal drill press speed, and no difficulty was experienced in obtaining a surface that required only a slight amount of polishing.

Self-Equalizing Chuck for Work with Irregular Bores

By N. P. DARASH, Cleveland, Ohio

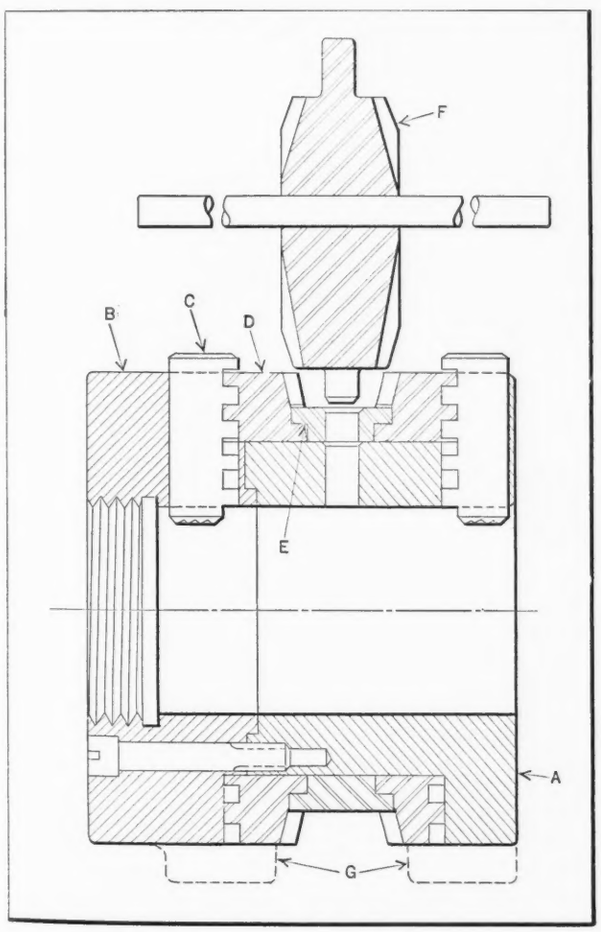
The centering of steel castings for differential housings proved to be a difficult problem in one plant and consumed a great deal of time until the chuck shown in the illustration was used. With this chuck, any variation in the diameter of the bore at either end of the housing or any distortion of the bore is compensated for by the equalizing action of the jaws.

The design of the chuck is very simple. It con-

sists of a body *A*, an adapter *B*, six jaws *C*, two scrolls *D*, a ring *E*, and a double-end wrench *F*. Body *A* is secured to the adapter *B* by screws. Scrolls *D* and ring *E* are free to rotate on the hub of the body. Teeth cut on the inner faces of the scrolls engage the teeth on either end of the wrench, while the spiral thread on the outer faces of the scrolls engages teeth cut on the six jaws. Thus, as the wrench is rotated, the scrolls rotate in opposite directions and feed the jaws in or out. Openings in the differential housings permit the wrench to enter the chuck.

For the machining operation, the housing is placed over the chuck, with the six jaws inside the bore. To clamp the jaws against the bore, the end of the wrench with the short pilot is used. This pilot is inserted in one of twelve holes drilled radially in ring *E*. When in this position, the wrench teeth engage the teeth in both scrolls. The wrench is now rotated until the jaws come in contact with the bore of the housing.

If one set of jaws has not yet come in contact with the bore, the other set will remain stationary against the bore and the wrench will roll on the inner face of the scroll that actuates the latter set and rotate the opposite scroll. This scroll will thus force the unclamped set of jaws out against the bore. In this way, when all six jaws are in contact with the bore, additional rotation of the wrench will rotate both scrolls and force all the jaws against the bore with an equal pressure.



Chuck with Six Scroll-operated Jaws that Adjust Themselves to Irregularities in the Work

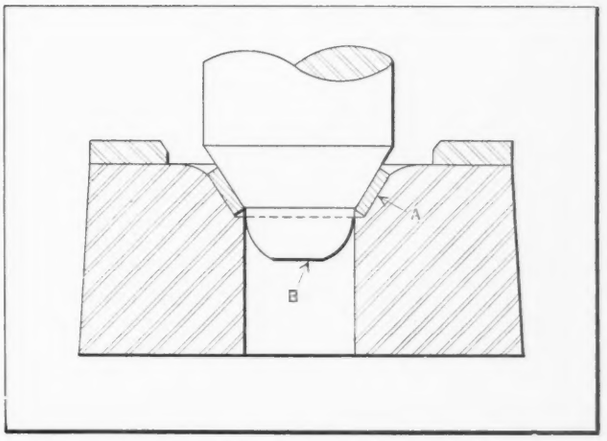


Fig. 1. First Forming Operation on Cylindrical Ring in which the Blank is Formed to a Conical Shape

In unchucking, the opposite end of the wrench is used, the long pilot passing through a hole in ring *E* and entering one of six holes drilled in the chuck body. By rotating the wrench, both scrolls are rotated, causing all six jaws to recede the same amount.

Obviously, if the end of the wrench with the short pilot were used at this time, the wrench would be free to float with ring *E*, so that all the jaws would not recede at the same rate. Using this end would also result in awkward handling of the wrench. The jaws are keyed to prevent turning, which might result from the action of the scrolls. Should greater support be required for the scrolls, the body and adapter may be designed as indicated by the dotted outlines *G*.

Drawing Dies for Making Rings from Flat Stock

By WILLIAM C. BETZ, Master Mechanic, Fafnir Bearing Co. New Britain, Conn.

A unique method of making rings from flat sheet metal is shown in the accompanying illustrations. The first operation will not be described, as it consists merely of cutting the washer-shaped blanks. These blanks are placed in the die shown in Fig. 1, where they are formed to a conical shape, as indicated at *A*. The hole pierced in the blank is made slightly smaller than the pilot *B* so that there will be friction between the pilot and the blank. This allows the pilot to assist in pushing the blank down against the tapered portion of the die. The pierced hole, however, should not be too small, as it may cause tearing of the work when the pilot passes through.

The part should be formed to as steep an angle

as possible in this die in order to facilitate the final operation, which is accomplished in the die shown in Fig. 2. Here the large end of the cone-shaped part rests against the sides of the bell-mouth in the die, and it is held centrally by means of the two spring-operated arms *A* (see also plan view, Fig. 3).

As the press ram descends, the punch *C* enters the hole in the part, and on the continued descent of the ram, the stripper *D*, coming in contact with the part, slides up on the punch until it comes against the bottom surface of the punch-block. As the ram descends farther, the part is pushed downward, and its outer skirt is forced in radially against the punch.

This action continues until the lower end of the part enters the straight hole in the die; at this time, the forming of the part to its true cylindrical shape takes place. The forming continues to the end of the stroke, when the lower end of the part is forced against the knock-out *E*. By adjusting the stroke of the press, sufficient pressure between the ends of the stripper and the knock-out may be obtained to square up the ends of the ring, and thus eliminate subsequent trimming.

If the production is not great enough to warrant the construction of the die illustrated in Fig. 2, a simplified design, such as a standard push-through die, can be used for this job. The upper part of the die should be made bell-mouthed, however. In that case, a separate trimming operation is required, which decreases the rate of output. However, in most cases, the saving in production time effected by eliminating a separate trimming operation is sufficiently important to warrant the additional expense of incorporating a knock-out arrangement in the die, as illustrated.

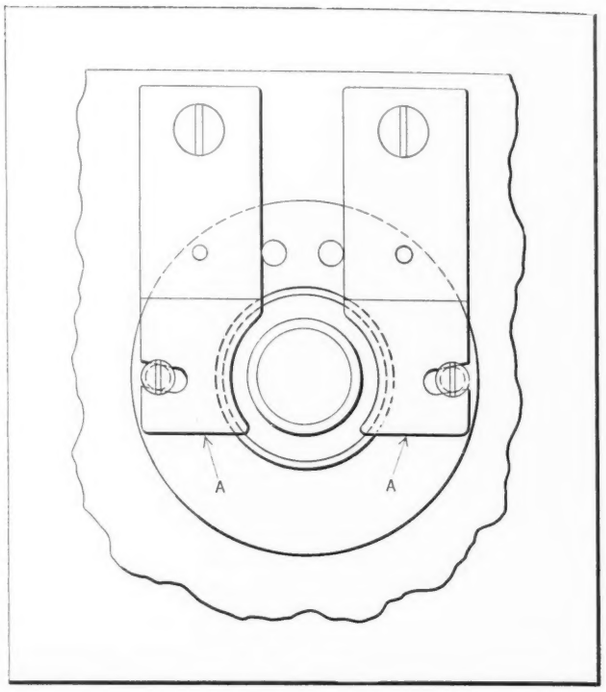


Fig. 3. Plan of Die, Showing the Locating Arms

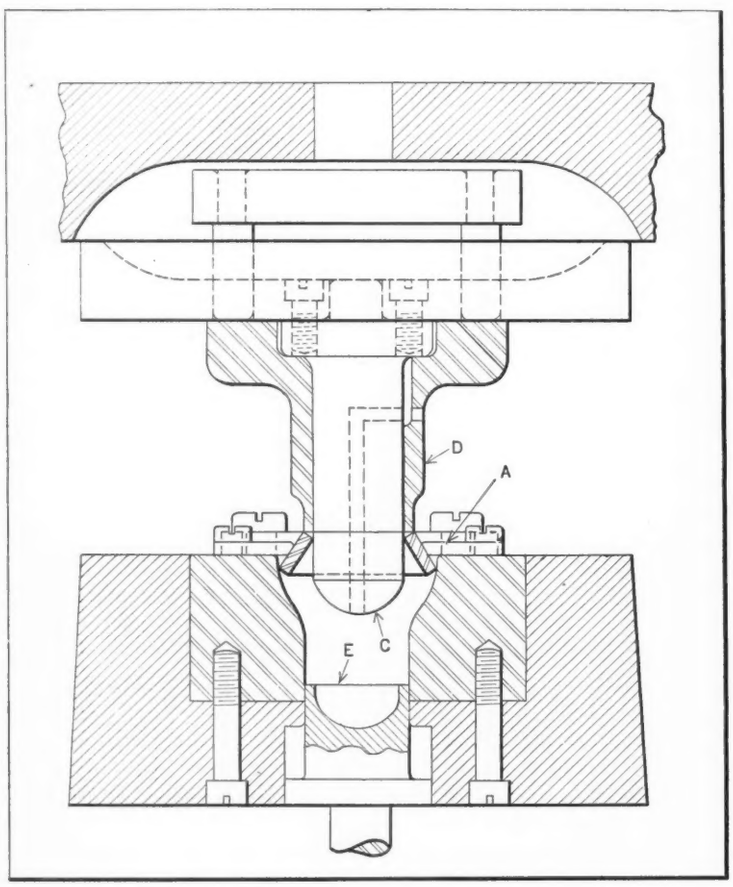


Fig. 2. Second and Final Forming Operation, in which Conical Part is Formed to a Cylindrical Ring

* * *

Activity in Industrial Rehabilitation

Industrial rehabilitation means the installation of new cost-saving equipment in place of old, inefficient, and wasteful machinery. In line with this idea, the Pennsylvania Sugar Co., Philadelphia, Pa., has installed fifteen new Westinghouse turbines which contribute to the saving of $1000 a day in steam costs effected by the new steam plant installed by the company. The new turbine installation is expected to pay for itself in two years through the difference between present cost of operation and the cost of operating the old plant.

The Bogalusa Paper Co., Bogalusa, La., is engaged in a program of improvements and installation of new equipment, which, when completed, will cost $1,250,000. The enterprise and confidence of these firms outside of the metal-working and machine-building industries should encourage many machinery firms to proceed with their own rehabilitation programs.

A Yardstick for Buying Welded Machine Parts

Specifications that can be Used as a Guide in Placing Orders for Welded Construction

By ALLAN S. AUSTIN
Sales Manager, Welding Division
The Austin Co., Cleveland, Ohio

THE steadily increasing use of welded-steel construction for machine parts indicates rather clearly the future possibilities for this method. The use of welding in the machine field, heretofore confined largely to maintenance or repair work, is now becoming an important factor in the production of new equipment; this article will confine itself to a discussion of the problems involved in specifying and purchasing welded-steel parts for use in regular production. Every day new applications are being developed and many promising fields are scarcely touched at the present time. Even among those companies now using welded-steel construction regularly in their machine parts, there is considerable confusion regarding the technical points of the design and the shop practice that should be used under varying conditions of design or service. The purpose of this article is to offer a guide for the specifying and purchasing of welded-steel parts which may be of some help in evening up the differences in practice of various bidders.

In the present rather early stage of development of welded-steel construction there is nothing that resembles a standard practice or procedure in the various fabricators' shops. Even if given a drawing showing a piece designed for welded construction, the shop fabricator is left largely to his own discretion as to the technical procedure involved in fabricating the piece. Whether to use bare welding rod or coated rod; whether to subject the piece to furnace stress relieving or to mechanical stress relieving or to no stress relieving at all; whether the flame cutting should be done by hand or automatically; the proper carbon content of the steel—these and numerous other points usually are not referred to on the drawings and are open to question. Even more important is the exact procedure that governs the welding itself. Are the individual welders left to their own discretion as to the size and type of welding bead or is there competent inspection to check their work?

Comparison with Other New Industries

The situation in this young industry at the present time is somewhat analogous to the condition existing in the radio industry about ten years ago. Any radio that would talk was sufficiently wonderful and interesting to sell. The buyer knew little or nothing about the type of wiring circuits, the number and type of tubes, or other technical information which any purchaser of a radio nowadays would have very definitely in mind. Today, however, a large part of the wonder and mystery of the invention has been dispelled by a more general knowledge of the actual facts involved, and this has enabled purchasers to know what they are buying and to buy the machine best suited to their particular requirements.

The accompanying specifications for welded-steel construction are offered as a yardstick for the measurement of service and quality in the comparatively young welding industry. These specifications are written with alternate clauses, in recognition of the diversity of requirements for various types of equipment. They are in no sense iron-clad rules, but rather outline the points that should be covered in any complete specification for welded construction and are suggestive of various ways of covering these points properly. The parenthetical remarks following the suggested clauses are intended to give further information regarding the proper use of the clauses and the considerations involved in writing them.

The use of a set of specifications similar to these will do a great deal toward the elimination of unsatisfactory or questionable work, and will enable the purchaser to compare his bids on a much more equitable basis than has usually been the case in the past. These specifications offer what might be termed a set of rules for a new game, which should immediately improve the playing condition for both teams.

Specifications for Welded-Steel Machine Parts

In writing specifications, each of the following main headings should be covered by one or more of the lettered paragraphs under each head. Parenthetical remarks are intended as guides to the selection of the proper paragraphs, and are not intended to be included in the written specifications.

I. Materials

(a) All material used is to be *new* rolled steel, in accordance with the Manufacturers' Standard Specifications, and is to be of open-hearth structural grade. Carbon content is to be held within limits of 0.15 to 0.25 per cent. This steel shall be "silicon killed."

[This produces what is generally called "arc-welding quality" steel and is used in the majority of cases where no special alloy is required. When any unusual amount of bending or forming is required, a lower carbon content—0.10 to 0.15 per cent is desirable. For especially hardened wearing surfaces or guide bars, a carbon content of 0.35 to 0.45 per cent may be obtained. This material will command a higher pound price and should only be specified where required.]

II. Flame-Cutting

(a) Machine flame-cutting is to be employed on all irregular outlines, holes, or openings as shown on drawings. This flame-cutting is to be of such quality as not to

exceed a variation of 1/16 inch from indicated dimensions, and to leave a clean, smooth edge, free from ragged projections, so that no further finishing will be required.

(b) Machine flame-cutting is to be employed on the edges of all plates, whether straight or irregular, of 3/4 inch thickness or greater.

[Both of the foregoing paragraphs might well be included in any specification. Paragraph (b) refers to the fact that shearing of plates 3/4 inch or over causes considerable deformation of the metal and leaves a ragged edge.]

III. Shearing and Sawing

(a) All edges not otherwise specified in (II) may be sheared or sawed at the discretion of the manufacturer. All burrs, fins, etc., to be removed before assembly.

IV. Forming and Bending

(a) Cold-forming may be done on plates up to and including 3/4 inch thick, with a minimum radius of three times the thickness of the plate. This forming shall be accurate to within 1/8 inch of the dimensions as shown on the drawings. Hot-forming is permitted on all bends at the discretion of the fabricator.

[The limits in the preceding paragraph are based on material as specified in I-(a). Any special alloys may change the feasibility of working to these limits. If it is essential to obtain a smaller radius than allowed by the preceding paragraph, a lower carbon content, as outlined in the comments under I-(a), may be specified to assist in obtaining this result. Generally speaking, the use of formed corners on machine parts is desirable on account of the great improvement in appearance which results, and because it is usually more economical to form a corner than to make a continuous weld.]

V. Welding Wire

(a) All welding wire used is to be of the covered or coated type, depositing a weld metal with the following minimum physical characteristics: Tensile strength, 65,000 pounds per square inch; elongation, 20 per cent in 2 inches; specific gravity of deposited weld metal, 7.80; fatigue 28,000 pounds per square inch.

[The above physical values are those used by the U. S. Navy in purchasing coated welding wire. Weld metal deposited by such wire may be described briefly as being "as good as the parent metal." Such joints, when tested, almost always fail entirely outside of the weld. This type of weld metal should be specified on all machine parts subjected to live stresses, impacts, or shocks. Bare wire, covered in Paragraph (b), may be used where static loads only occur.]

(b) Bare, or uncoated, wire may be used only where indicated on the drawings.

[Weld metal deposited by bare, or uncoated, wire will usually develop none of the physical properties noted in the foregoing for covered wire. In particular, bare wire is deficient in elasticity or deformation under load, and thus, if used where live stresses, impacts, or shocks occur, may readily crack and fail. Generally speaking, the use of bare wire is poor economy.]

VI. Welding Procedure

(a) All welding is to be done with modern, controlled-amperage electric arc-welding machines of sufficient capacity for the class of work being handled.

(b) Welding machine operators shall be thoroughly qualified graduates of an approved welding school or have equivalent experience. They must be experienced in the fabrication of machine parts by welding.

(c) Continuous inspection of operators shall be maintained by a competent foreman, who at any time may require a weld or "coupon" to be chipped out or ground to expose its cross-section. His decision shall be final in any questions relating to quality of welding.

[Paragraph (c) is the only one that can really insure proper welding being done, and should be included in all cases. The essential point involved is that the welding operator must not be the judge of his own work.]

(d) Material shall be thoroughly cleaned of rust and scale at all points where welds occur.

(e) All welding beads shall be continuous and of the size specified on the drawings. Where no size is specified, the minimum may be used.

[Continuous welding beads of the proper size form a connection between two members that will develop the full strength of these members. This type of welding, then, should be specified only when the connected members are fully stressed and it is necessary to transfer these stresses from one member to the other. When this is not the case, use one or more of the following paragraphs.]

(f) All exposed welding beads shall be continuous, with the size of fillet as shown on the drawings. When no size is specified for fillet, the minimum size shall be used.

[Continuous welding is desirable on the exterior of machine parts for the sake of appearance. On jigs, fixtures, etc., where appearance is not an item, intermittent welding, as specified in (g) and (h) may be permitted.]

(g) All welding beads shall be of the 50 per cent intermittent type as follows: A welding bead of 3 inches shall be laid down, then an equal number of inches without weld, and this procedure repeated.

(h) All welding beads shall be of the 33 per cent intermittent type as follows: A welding bead of 2 inches shall be laid down, then a space twice the length of the bead shall be left, and this procedure repeated.

[Intermittent welding may properly be used in many cases, and has the advantage of removing to a large extent the tendency to warp caused by continuous welding. The amount of required weld can be calculated on a basis similar to that used in determining the number of rivets in structural fabrication, and the spacing can be controlled in a similar way.]

VII. Fillets

(a) All fillet welds shall be reinforced or of a larger cross-section than the area of a right triangle whose equilateral legs equal the length of the specified fillet (see illustration).

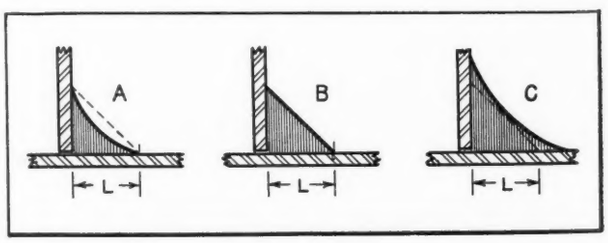


Illustration Shows at A Under-sized Fillet which is Not Permissible to Use; at B, Theoretically Perfect Fillet; and at C, Reinforced Fillet Such as is Required

(b) Size of fillet shall be interpreted to mean the length of one of the equilateral legs. Fillets shall conform to the size indicated on the drawings, and when size is not indicated, may be of minimum size.

VIII. Stress Relieving

(a) Mechanical stress relieving shall be given each pass of the welding bead. This shall be accomplished by means of a rough peening tool in a compressed air hammer. The entire surface of the weld shall be thoroughly peened, and this operation shall be repeated for each pass of welding bead previous to the next pass, if any.

[This type of mechanical stress relieving is very effective for relieving the cooling strains set up by the heat of welding, and when properly done will give complete satisfaction. This is the method ordinarily used, and is recommended as a minimum requirement for all machine parts.]

(b) Furnace stress relieving shall be given to plates (as shown on drawings) previous to their assembly in the welded structure. Furnace stress relieving shall be done as follows: The material shall be placed in an annealing furnace, which shall then be heated to 1200 degrees F. This temperature shall be maintained for one hour per inch of maximum thickness of metal. (Example: A 1 3/4-inch plate would be held at 1200 degrees F. for 1 hour and 45 minutes.) The piece should then be cooled gradually and uniformly.

[Furnace stress relieving is recommended for any heavy plates—1 1/2 inches or over—which are to be machined over any large area. This is desirable if the surface is to remain true after machining, due to the stresses which are often inherent in heavy rolled plates. When using procedure (b) to cover such heavy plates, procedure (a) should be included to cover stress relieving of the welds.]

(c) Furnace stress relieving shall be applied to the complete assembly after all welding has been completed. Furnace stress relieving shall be done as follows: The material shall be placed in an annealing furnace, which shall then be heated to 1200 degrees F. This temperature shall be maintained for one hour per inch of maximum thickness of metal. *(Example:* A 1 3/4-inch plate would be held at 1200 degrees F. for 1 hour and 45 minutes.) The piece should then be cooled gradually and uniformly.

[This paragraph takes the place of both (a) and (b) and is the most complete job of stress relieving possible. It is also the most costly, and should be specified only where a piece is made up of heavy sections, involving a large amount of heavy welding, or is subject to unusually severe service, or where a combination of these conditions exists.]

IX. Finishing and Cleaning

(a) All welds shall be brushed clean and free from scale.

[This paragraph is to be used whenever a coated or covered welding rod is specified; see Section V.]

(b) All rough spots, sharp corners, or ragged edges shall be ground or chipped smooth, so that no further finishing shall be required by the purchaser.

[This is recommended as being the best safeguard against excessive finishing and cleaning costs in the customer's own shop.]

(c) Surfaces of all plates, both inside and outside, shall be brushed or scraped entirely free from rust, scale, or other deposit, leaving a clean surface of the metal.

[This paragraph must be included if the following paragraph (d) on painting is to be used. It is especially necessary also whenever any furnace stress relieving is specified, as this process causes a considerable amount of scale on the plate surfaces. Any shop specializing in the production of welded-steel machine parts is equipped to do this work cheaper than the average machine builder.]

(d) No iron cement or other type of filler is to be applied to welding beads or flame-cut edges by the fabricator.

[The intent of this paragraph is to facilitate inspection of the welding beads by the purchaser, and is not intended to discourage the use of such fillers as a means of improving the appearance of these machine parts. Such filler is properly applied, however, in the purchaser's shop rather than in the fabricator's shop.]

(e) All surfaces both inside and outside, shall be painted with one shop coat of machinery gray primer.

[The small additional cost incurred by adding this clause is usually justified by the protection given by such a shop coat during shipment, as the piece will then be delivered as clean as it leaves the fabricator's shop, avoiding entirely any finishing and cleaning in the purchaser's shop. The experience of the Austin Co. has demonstrated this procedure to be an economy.]

X. Machine Work

(a) No machine work is to be included in the fabricator's quotation. At all points marked *f* (finish), an allowance of 1/4 inch is to be made for machining.

(b) The fabricator's quotation is to include all finishing as called for on the drawings specified (list drawing numbers). No drilling, tapping, or threading is to be included.

(c) The fabricator's quotation is to include all finishing, drilling, tapping, and other machine work as called for on the drawings specified (list drawing numbers).

[These are obviously alternate clauses to be used where applicable.]

XI. Delivery

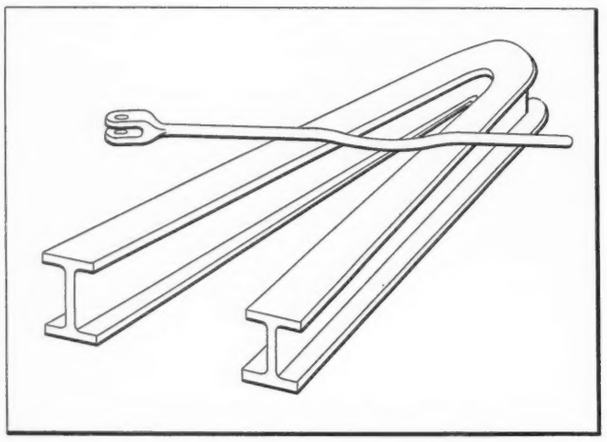
[Indicate whether lump sum quotation is to be made f.o.b. the fabricator's plant or with delivery allowed, etc. Also indicate requirements as to date of delivery. Purchasers should keep in mind that any unusually short delivery requirements may force the fabricator to obtain some or all of his material from warehouse, which material will cost approximately 50 per cent more than if the delivery time permits of mill delivery of the material.]

What is a Thrustor?

An article in March MACHINERY will describe the general construction and application of the electric-hydraulic thrustor, a new device that has many applications in machine design. It is intended for imparting a uniform straight-line movement, at all times under complete control. The new device can be used for applying pressures up to 6000 pounds, and is finding increasing use in many industries—steel mills, machine shops, mines, and wire-drawing plants. The entire device is controlled by switching equipment which starts and stops a motor in accordance with the application of the device. The operation is rapid and without shock; the speed of operation can be adjusted within predetermined limits; and varying speeds to meet any operating conditions can be obtained.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



I-beam Bent at an Angle to Provide an Adjustable Anvil for Straightening Rods or Pipe

Bent I-Beam Serves as a Straightening Device

In a jobbing shop the straightening iron shown in the illustration is used for hammering bends out of rods and pipes. The iron is merely a piece of I-beam having a sharp bend at an angle of about 30 degrees. The part to be straightened is thus afforded support at each side of the bend at points depending upon the length of the distorted part of the work. This device can also be used in roughly testing a part for straightness by rolling it along the top of the beam.

Washington, D. C. G. A. LUERS

Hacksaw Set-Up in which One Angle-Bracket is Formed from a Square Bar at Each Cycle

It is customary to regard a power hacksaw as a cutting-off device only, but sometimes a finished part can be turned out on this machine. For example, with the arrangement shown in the illustration, one finished angle-bracket *D* is formed from a solid square bar at each cycle.

The procedure is as follows: The square bar is gripped in the vise, as indicated at *A*, and the first piece sawed off. At *B*, the sawed-off piece is placed near the end of the bar and the latter is blocked up a distance slightly greater than the thickness of the finished brackets. The next cut produces another block and also saws out one side of the first block.

Next, the first block is turned over (see view *C*) so that the saw cut is parallel with the bottom of the vise, and the second block is placed beside this block. This time the cut produces a finished angle-bracket from the first block, saws down one side of the second block, and produces another solid block.

Thus, after this preparatory process, a completed angle-bracket is produced at every cycle. The writer uses a sheet-metal gage, as indicated, to position the bar and pieces in the correct relation to the vise jaws after each cut.

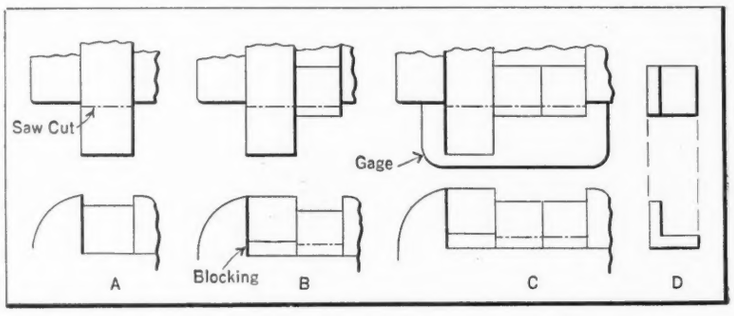
Hamilton, Ontario, Canada FRANK MOORE

Replacing Liquid with Steel Balls in Expanding Dies

There are many jobs that are now being done with hydraulically operated expanding dies that could be done more easily and with less dirt and "muss" by means of small steel balls. Instead of using liquid or rubber, hardened steel balls about 1/32 to 1/16 inch in diameter are used. A punch or plunger having a cone-shaped end wedges the balls aside as it enters the work. The marks produced by the balls will be hardly perceptible on the outside of the work if the stock is of sufficient thickness.

In using balls, they should be lubricated with a thin oil, and the excess oil removed by placing them in the bowl of a centrifugal extractor for a fraction of a minute. Sand also can be used to replace the liquid, although the balls are far superior in that they do not wear the punch so fast and the action is easier, due to their smoothness and the lubrication of the ball surfaces. When a hammered effect is required, balls of various sizes can be used, the entire mass being thoroughly mixed to obtain a uniform distribution of the balls.

New Britain, Conn. WILLIAM C. BETZ



Set-up for Producing a Finished Angle-bracket at Each Cycle of a Hacksaw

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

A. L. M.—Under ordinary conditions, what type of machine tool will remove the greatest volume of metal per horsepower consumed? Are tables available that show the average relative efficiencies of lathes, milling machines, etc., in removing metal, based on the number of cubic inches removed per minute per horsepower? How does the efficiency of the modern grinding machine compare with other machine tools as regards the amount of metal removed per horsepower consumed?

Answered by R. E. W. Harrison, Secretary Executive Committee, Machine Shop Practice Division, American Society of Mechanical Engineers

The science of removing metal by tool action has made steady progress during the last twenty-five years. Probably the greatest improvement has been registered by the grinding wheel, which during this period has emerged from the stage where it functioned by purely abrasive action to the point where it is now rightly regarded as a multiple-tool cutting implement that removes chips or metal having all the characteristics of those produced in the lathe or other machine tool.

Referring to the accompanying chart, which shows the comparative horsepower requirements of different types of machine tools, it will be noted that the grinding machine still requires far more horsepower than other tools to remove a given amount of metal, and that this machine is rightly a finishing tool only. However, the vast strides made in the manufacturing technique of the foundries and forge shops have eliminated the large finishing allowances required a few years ago. Under these conditions, the grinding machine is becoming justifiably attractive as a tool for both roughing and finishing operations, despite its relatively high power requirements.

From the chart it will be noted that for each 10 horsepower applied to the point of contact between the wheel and work, we can remove one cubic inch of metal. This rate is influenced very little by the hardness or softness of the material being ground. It is a noteworthy fact that the precision grinding machine, considered as a metal removing tool, is less subject to variation in maximum cutting efficiency than any other type of machine.

In the milling machine field, cutting efficiency has been increased from 1/3 cubic inch per minute per horsepower up to an average of 2 cubic inches per minute per horsepower. The steps taken in this period of transition have been the change from narrow- to wide-spaced-tooth cutters; the adoption of high-speed steel cutters; and the use of built-in motor drives in place of the cone pulley or single belt drives.

It is well to note that, so far, the use of tungsten-carbide tipped cutters has not increased the amount of metal that can be removed in a given time. In fact, there is generally a drop of about 10 per cent in the rate of metal removal which, however, is more than compensated for, in the long run, by greater durability, fewer regrindings, and ability to finish work at one cut.

The metal removal history of the other basic machine tools has progressed step by step with the milling machine, the milestones being the successive introduction of high-speed steel, single-pulley drive, built-in motor drive, increased rigidity of the machines, and tungsten-carbide tools. The designer is once more endeavoring to give the machine a degree of rigidity that will again put it ahead of the cutting capacity of the cutting tool materials now available; it is the story of projectiles and armor plate all over again.

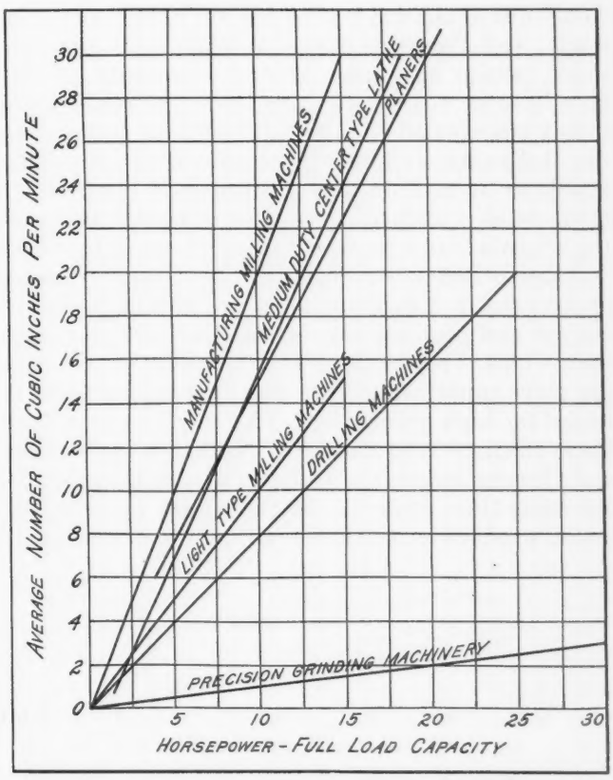


Chart Showing Volume of Metal Removed per Minute per Horsepower by Different Types of Machine Tools Operating under Good Working Conditions

Automotive Engineers Discuss Tooling Costs

The annual meeting of the Society of Automotive Engineers was held January 23 to 26 at the Hotel Book-Cadillac, Detroit, Mich. The production session, of which V. P. Rumely was chairman, held its meeting Thursday afternoon, January 26. J. E. Padgett, of the Spicer Mfg. Corporation, read a paper on "Some Principles of Flexible, Accurate, Low-Cost Tooling." Colonel James L. Walsh, of the Guardian Detroit Union Co., spoke on "Automotive Aspects of Work of the Committee on the Rehabilitation of Industry." At a luncheon preceding the meeting, K. T. Keller, general manager of the Chrysler Corporation, spoke on "Production, a Human Equation."

In his paper on low-cost tooling, Mr. Padgett stated that increasing demands for changes in automotive products will be the rule during the next few years. Managements will be more than ever concerned about (a) loss of sales if changes are not made; (b) excessive cost of tooling if changes are made, which cost may offset temporarily all the gain in sales; (c) resistance of the shop organization to any change; and (d) the difficulty of persuading the designing engineer to consider properly the problems of manufacture. Since such changes are made in all successful companies, the manufacturing division must be ready to carry them through.

After direct labor costs, the next largest items of expense in a machine shop are generally depreciation and obsolescence of machines, fixtures and tools. This is especially true when changes are taking place rapidly, and even more so when a plant is tooled for high production. The only way to reduce these charges is to make the machines last longer and thereby reduce the rapidity of obsolescence. At the same time, it is necessary to keep up with the latest production methods. If new machine tools are needed or if new developments of great value are made, these machine tools must be purchased.

"In a general consideration of machine shop practice," said Mr. Padgett, "we must decide on the correct place for simple single-spindle or single-operation types of equipment, as compared with multiple-spindle, multiple-operation machines. My experience is that the high-production multiple-tool machine seldom saves. Many cases can be mentioned where such machines are a positive saving; but in many other cases they have been found to be a source of great expense and trouble, especially when a change must be made and the cost of retooling becomes large. To be economical, these machines must be capable of running on a given job over a relatively long period; but seldom, in these days, does any product remain fixed in its design long enough to amortize the tooling. In addition, there are the larger percentage of 'down time,' set-up time, and various delays when any single unit gives trouble and stops the entire group of operations.

"I feel that the highly special high-production multiple-operation equipment is like the investment type of banking, making large profits in boom times, but becoming badly frozen and highly expensive in times of low production or rapid change. The simple machinery seems to be a little more costly during boom times; but when adverse conditions come about, this equipment is good for almost anything and in any quantities, can be changed rapidly and at low cost, and over a long period is the safest and most profitable to use."

In concluding his address, Mr. Padgett again assured his audience that we shall need to prepare for numerous and rapid changes in the automotive industry during the next five years.

Do You Know

how a steel pinion weighing 20,000 pounds can be hardened without the use of a furnace?—see page 379.

what "Lo-Ex" is and for what purpose it is used?—see page 389.

that wheelbarrows are now made from aluminum?—see page 377.

how to drill slate and marble?—see page 407.

for what purposes zinc-coated steel and copper-coated steel are used?—see page 392.

what results tungsten-carbide tools have given in cutting wood?—see page 382.

what precautions to take in welding aluminum?—see page 403.

what wheels to use in grinding chilled iron rolls?—see page 375.

Welding Aluminum with the Metallic Arc

Equipment Required and Procedure Followed in Making Arc Welds in Aluminum

By JOHN J. BOWMAN, Metallurgical Division, Aluminum Research Laboratories New Kensington, Pa.

FUSION welding is generally defined as "that method of welding in which the parts are united in a molten condition without the application of pressure," and is considered to include gas (or torch), electric arc, and one form of thermit welding. For the present, let us consider only metallic arc welding with flux-coated, non-ferrous electrodes. Arc welding of aluminum and its alloys is found to occupy a position in this particular classification.

As in the development of fusion welding in general, torch welding was the first type to be successfully applied to the fabrication and repair of aluminum products. This process has been used commercially for many years and has become of primary importance in the assembly of many articles built of aluminum. The rapid development of arc welding for other metals, however, created an insistent demand for improvement in the methods of arc-welding aluminum so that the process could be applied with greater commercial success.

Reference to welding literature shows that various methods have been proposed for arc-welding aluminum in the past, but many of these methods proved of doubtful value. Many reports of unsuccessful attempts to arc-weld aluminum can also be found, and statements that the metal cannot be successfully arc-welded are quite common, although there are statements to the contrary. A general analysis of the reports of failure points to the conclusion that, in almost every case, the investigator failed to appreciate the importance of a good flux properly used.

No doubt this failure can be accounted for by the fact that early developments in arc-welding steel in this country were with a bare electrode. Although we find that in Europe the covered or flux-coated steel electrode has been popular for many years, it is only in the last few years that the use of such electrodes has become popular here.

Flux-Coated Electrode Necessary for Arc Welds

The experience gained in torch-welding aluminum and its alloys has demonstrated that, although puddle welding of this metal is quite possible, the use of a flux gives much more reliable welds. Similarly, the need of a flux for arc welding is promptly shown by any attempts to use a bare wire. With the available basic information on torch-welding flux, the problem then became one of developing a suitable flux for arc welding and determining the best method of using this flux.

Obviously, the most practical way of using the flux is to have it form a coating on the electrode. In general, then, the flux should have the following characteristics:

1. When molten, it should be able to attack and remove any oxide film on the electrode and the material to be welded.
2. The molten flux, with the dissolved or suspended aluminum oxide, should have a specific gravity sufficiently below that of molten aluminum so that it will come to the surface of the weld very quickly.
3. The flux should bind together well, so that it will produce a good coating on the electrode. It should not be too deliquescent, as such a characteristic will make a coated electrode rather impractical.
4. The melting point of the flux should be slightly lower than that of aluminum, and the flux should be relatively stable at these temperatures. A flux meeting these requirements was finally developed and has proved quite satisfactory.

While the experiments with flux compositions were being made, investigations of the most suitable coating thickness were carried out. These tests showed that, although a comparatively thin coating on the electrode would supply sufficient flux to remove the oxide from the metal, a rather heavy coating was required to stabilize and control the arc. A coating thickness of about 0.035 inch on 1/8-inch electrodes grading down to about 0.025 to 0.030 inch on 1/4-inch electrodes was finally chosen.

Method of Applying Flux to Electrode

The coating is applied to the wire by hand-dipping in a flux paste made by mixing the dry flux with tap water in the proportions of about 4 to 1. To secure the proper coating thickness, the electrodes must be dipped about three times, and each coat should be thoroughly dried before the next is applied. After the last coat is applied, the electrode should be carefully dried and then baked to glaze the surface.

Drying may be done very satisfactorily in a well ventilated oven, but the temperature should be kept below about 100 degrees C. or the flux may chip and peel badly. Baking the final coat may be done at somewhat higher temperatures.

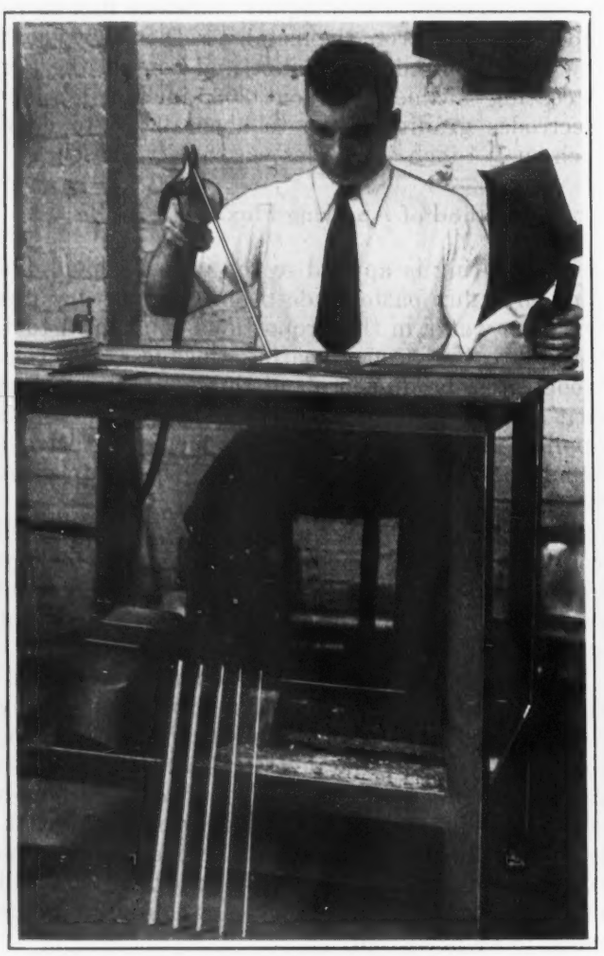
The equipment required for the metallic arc-welding of aluminum is no different from that usually used for the arc-welding of steel, and need not be discussed. Most of the investigations carried on so far have been with direct-current welding, although some very successful welding has been done recently with alternating-current machines. With the former, it has been found that a generator that will maintain a stable arc over its welding range is much to be preferred.

Most of the well-known machines now have such characteristics and are quite suitable for use in welding aluminum. Some machines may be encountered, however, that will produce a somewhat unstable arc at low currents and, in such cases, a resistance of about 1/3 ohm connected in series with the arc—that is, between the machine and either the electrode-holder or the ground clamp—will prove helpful.

The choice of polarity to be used for welding aluminum is a matter for the operator to decide. It has been found that, in most cases, either direct or reversed polarity will prove satisfactory. Many flux-coated electrodes for use on other metals, however, are found to work somewhat better with reversed polarity, and it may be found that this polarity is advisable for aluminum, especially when welding the thinner gages of sheet.

Almost all the common types of joints can be metallic arc-welded on aluminum, but, of course, some of these are more difficult than others. The common butt joint is probably the most easily made,

Fig. 1. In Welding Aluminum with the Metallic Arc, the Electrode is Held at Approximately the Angle Shown Here and the Work is Placed Directly on the Table Top to Support the Weld



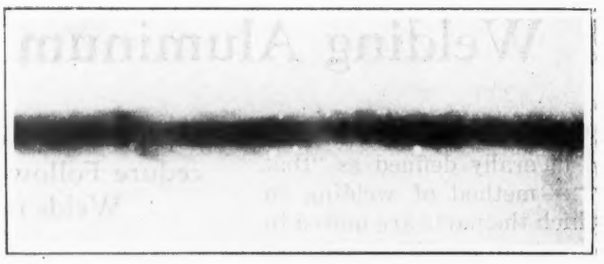


Fig. 2. Radiograph of a Metallic Arc Weld in 1/8-inch Aluminum Sheet Showing Porosity Commonly Present. Weld Made with Direct-current Machine, 1/8-inch Electrode, and about 80 Amperes

and certainly the most reliable. Outside corner welds are also reasonably simple. Lap and fillet welds are somewhat more difficult for the average welder, and it is not always a certainty that proper fusion in the right-angle corner of the fillet has been secured. Scarfing the edge of the top plate in a lap joint, so that the edge is not vertical but slopes back a little will often improve the results.

Butt joints in material less than 1/4 inch thick require no preparation for welding, as the average machine of 300 to 400 amperes capacity can readily produce complete weld penetration. Material thicker than about 1/4 inch, however, should be prepared by chipping the edges to a single or double vee. A lip of at least 3/16 inch should remain after chipping.

It will be found necessary to back up all butt welds with some type of supporting plate, since the melted aluminum in the weld has a tendency to be blown through by the action of the arc. A copper or aluminum plate placed under the weld will usually prove very satisfactory. Aluminum is somewhat better for this purpose than copper. A shallow groove in the backing plate placed directly under the weld will improve the contour of the penetration bead.

Procedure in Making the Welds

Spacing is not usually necessary for short welds in the heavier gages of metal, but for lighter gages and long welds, it is believed advisable. A progressive spacing of about 1/16 inch per foot for the lighter gages and about 1/8 inch per foot for the heavier gages is generally sufficient.

The actual welding operation, performed as illustrated in Fig. 1, is so much like that used on other metals that the average steel welder should have little trouble with aluminum. He will probably be bothered in his first attempts by the rapid rate of electrode consumption and speed of movement along the seam, but after a little experience will become accustomed to these factors and have little trouble.

A very short arc should always be used in welding aluminum and, in contrast to steel welding, the electrode should move only in the direction of weld-

ing (in butt welds). Weaving the electrode along a butt weld is not only unnecessary, but should be avoided. In making lap or fillet welds, some weaving is advisable, and in this work the welder will probably find his customary practice satisfactory.

Requirements for a Suitable Electrode

Experience has shown that the most satisfactory aluminum alloy for use as an electrode is the one containing 5 per cent silicon (95 per cent aluminum). This alloy has a lower melting point than pure aluminum (2S) and is quite fluid when in the molten state. In addition, it possesses a small solidification shrinkage and has good hot-strength.

The diameter of electrode to be used will depend to some extent on the welder's preference, but a good rule to follow is to use a diameter about equal to the sheet thickness. Exceptions to this rule, of course, exist in the thinner and thicker gages, since a 1/8-inch electrode is about the smallest practical diameter and a 1/4-inch electrode is about the largest that a 400-ampere machine will melt. The most commonly used sizes are probably 1/8 inch and 3/16 inch.

A current of about 90 amperes should be used with a 1/8-inch electrode, about 200 amperes with a 3/16-inch electrode, and about 300 amperes with a 1/4-inch electrode. Some variation from these values will, of course, be necessary, depending on the thickness of material being welded.

Metallic arc welding can be applied successfully to both commercially pure aluminum and its various alloys in any gage greater than about No. 14 B & S (0.064 inch). The process shows advantages over torch welding in speed, somewhat greater strengths, and less distortion. The increased speed is due to the higher temperature of the arc, while the improved strength and decrease in distortion are due to more localized heating.

Minimizing Porosity in Welds

This process, however, has one disadvantage which may or may not prove important. Up to the present time all metallic arc welds have been found to be somewhat porous, regardless of the welding procedure employed. This porosity is apparently of an entrapped-gas type, and is usually rather evenly distributed throughout the weld. It apparently does not affect the strength of the weld greatly but, in cases where the weld must be ground smooth, may detract from the finished appearance.

The 5 per cent silicon electrode seems to minimize the porosity (probably because of its lower melting point and greater fluidity), and it can sometimes be further reduced by using an over-size electrode and the highest permissible current. The radiograph reproduced in Fig. 2 shows a metallic arc weld in 1/8-inch material and illustrates the porosity usually observed. This weld was not machined before being radiographed, and it is quite probable that much of the porosity is in the reinforcement bead.

Method of Finishing Weld

The completed weld is often left in the "as welded" condition, but there are times when a smooth surface is desirable. In such cases, it is probably better to chip some of the excess metal from the reinforcement bead and hammer the weld to the desired size. When this is to be done, the weld should be placed so that it can be backed up during the hammering operation. Grinding off the excess metal of the bead can also be easily done, if preferred, but it is not advisable to polish the surface, since the 5 per cent silicon alloy of the weld will show a color difference, compared to the adjacent sheet.

Regardless of the mechanical treatment given the finished weld, it is essential that the flux (slag) remaining on the metal after welding be completely removed. The flux is designed to attack aluminum oxide and, since the oxide is more resistant to attack than the metal, any flux remaining after welding may cause corrosion. The slag is usually quite brittle, and most of it can be removed by chipping or with a stiff (wire) brush.

The only sure way to secure complete removal, however, is to wash the weld or the entire assembly in about a 10 per cent nitric or sulphuric acid solution. When it is possible to soak the complete assembly in a warm acid bath for some time, the flux removal is more sure than with any other procedure. Such a procedure is not always possible, however, and when it is followed, it is necessary to wash or scrub the weld carefully. A careful rinse with fresh water should follow the acid bath.

On account of the importance of flux removal on welded aluminum structures, lap welds are usually not considered good practice. Such joints entrap some flux between the lapped sheets and its complete removal in the acid bath is extremely doubtful. This, coupled with the fact that a butt weld is considered more reliable and is certainly less subject to laps and cold shuts, leads to the general recommendation that a butt joint be used whenever possible.

Strength of Welded Joints

Butt-welded joints made with the metallic arc have been found to develop mechanical properties quite a little better than those made with the oxy-acetylene or oxy-hydrogen torch, but they do not, except in the case of annealed sheet, have strengths equal to the unwelded sheet. Aluminum and its alloys are supplied in annealed, cold-rolled (to different degrees), and heat-treated tempers. The heat of welding partially anneals an area adjacent to the weld—except, of course, in material already in the annealed condition—and results in some loss of strength.

It is evident from this that 100 per cent strength can be expected only in the case of a weld in annealed material. In addition, the weld proper is essentially a casting, and therefore has a lower

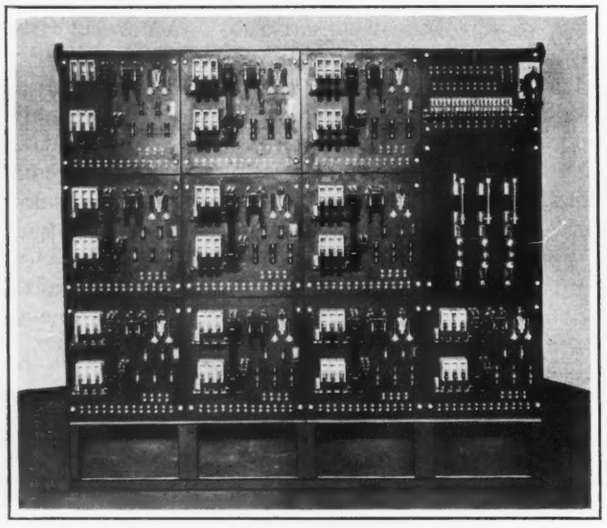
elongation than the welded sheet. On account of these losses in properties, welding is not generally recommended for joining parts made of the heat-treated, strong aluminum alloys; although welding these alloys is entirely possible.

The statement was made earlier in this article that practically all the work done so far with the metallic arc was with a direct-current machine. It might be well to mention that some tests were made recently using alternating-current welders and that such machines appear to show promise. The tests so far conducted are of rather a preliminary nature, but suggest that the alternating-current arc can be used to weld much thinner material than the direct-current welder can handle, and that, in these lighter gages, the alternating-current weld is much less porous.

* * *

Automatic Electric Controls

The mechanical man would hardly think of a laundry as a place in which highly developed electrical control equipment would be used. He would probably be somewhat surprised to see such a large panel as the one illustrated installed in a laundry for automatically controlling the operation of ten washing machines. These machines are reversed intermittently by a motor-driven timing device in the upper right-hand corner of the panel, and yet no two machines can be reversed at the same time.



The Modern Laundry Uses Highly Developed Electrical Control Equipment

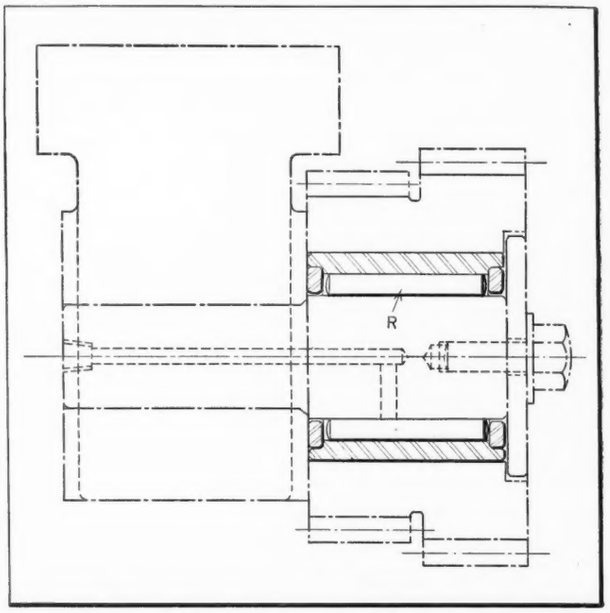
Accumulative current peaks are prevented by this arrangement. This control equipment was designed by the Monitor Controller Co., Baltimore, Md.

* * *

According to the *Compressed Air Magazine*, a steel plant in the Pittsburgh district cut down the amount of chips as much as 2000 tons annually by reducing the thickness of its hot saws 1/16 inch.

Applications of Bearings Using Small-Diameter Rolls

Every machinist and machine designer is well acquainted with the conventional types of roller bearings, but roller bearings with small rolls, such as shown in the accompanying illustration, are not so well known. Hence it is of interest to note that



Application of Small-diameter Rollers to Idler Gear Bearing of High-speed Press

the Bantam Ball Bearing Co., South Bend, Ind., is manufacturing millions of these small rollers in sizes ranging from 1/16 to 3/16 inch in diameter. The tolerance on these rollers generally ranges from $\pm$ 0.0001 to $\pm$ 0.0002 inch.

The accompanying illustration shows a typical application of small rollers *R* to a high-speed printing-press gear assembly. Small rollers of this kind are used in such applications as universal joints; Diesel-engine piston-pins and crankshafts; high-speed marine engines; printing presses; gears; transmissions; small rolling mills; rocker arms; and many other installations where limited space and peculiar operating conditions make this type of bearing advantageous.

* * *

Gray Iron Institute Meets in Chicago

The Gray Iron Institute, Inc., of which Arthur J. Tuscany, 4300 Euclid Ave., Cleveland, Ohio, is manager, met at the Congress Hotel, Chicago, January 26. The meeting was given over to a series of discussions of the major activities of the Institute. Among the subjects dealt with were: "New Specifications for Gray Iron and the Increased Opportunities Offered the Buyer and Seller"; "Marketing of Gray-iron Castings"; and "Improved Accounting Methods."

Tungsten-Carbide Tools for Drilling Slate and Marble

By J. M. HIGHDUCHECK, Assistant Superintendent
Manufacturing Equipment Department
Westinghouse Electric & Mfg. Co.

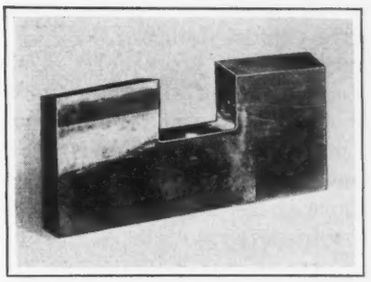


Fig. 1. Tungsten-carbide Tipped Cutter for Counterboring Slate and Marble

THE design of tungsten-carbide tipped tools used by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., for drilling slate and marble, is shown in Fig. 2. Flat drills of this kind have proved much more economical for drilling slate than tungsten-carbide tipped twist drills. However, twist drills tipped with tungsten carbide are recommended for drilling synthetic plastic materials and hard rubber. A speed of 75 revolutions per minute was used in drilling a 3/4-inch hole in slate with a high-speed steel drill, whereas a speed of 540 revolutions per minute is used with the tungsten-carbide drill. Using the same feed, 0.025 inch, the time per hole was 38 1/2 seconds with the high-speed steel drill and 18 seconds for the tungsten-carbide drill.

The number of holes drilled between grinds with high-speed steel drills averaged about 15, as compared with 60 for the tungsten-carbide twist drills and 325 for tungsten-carbide flat drills like the one shown in Fig. 2. In using high-speed drills at 75 revolutions per minute, regrinding was necessary at close intervals, in order to insure having the drill break through the bottom of the work without chipping too much from the edge of the hole. The tung-

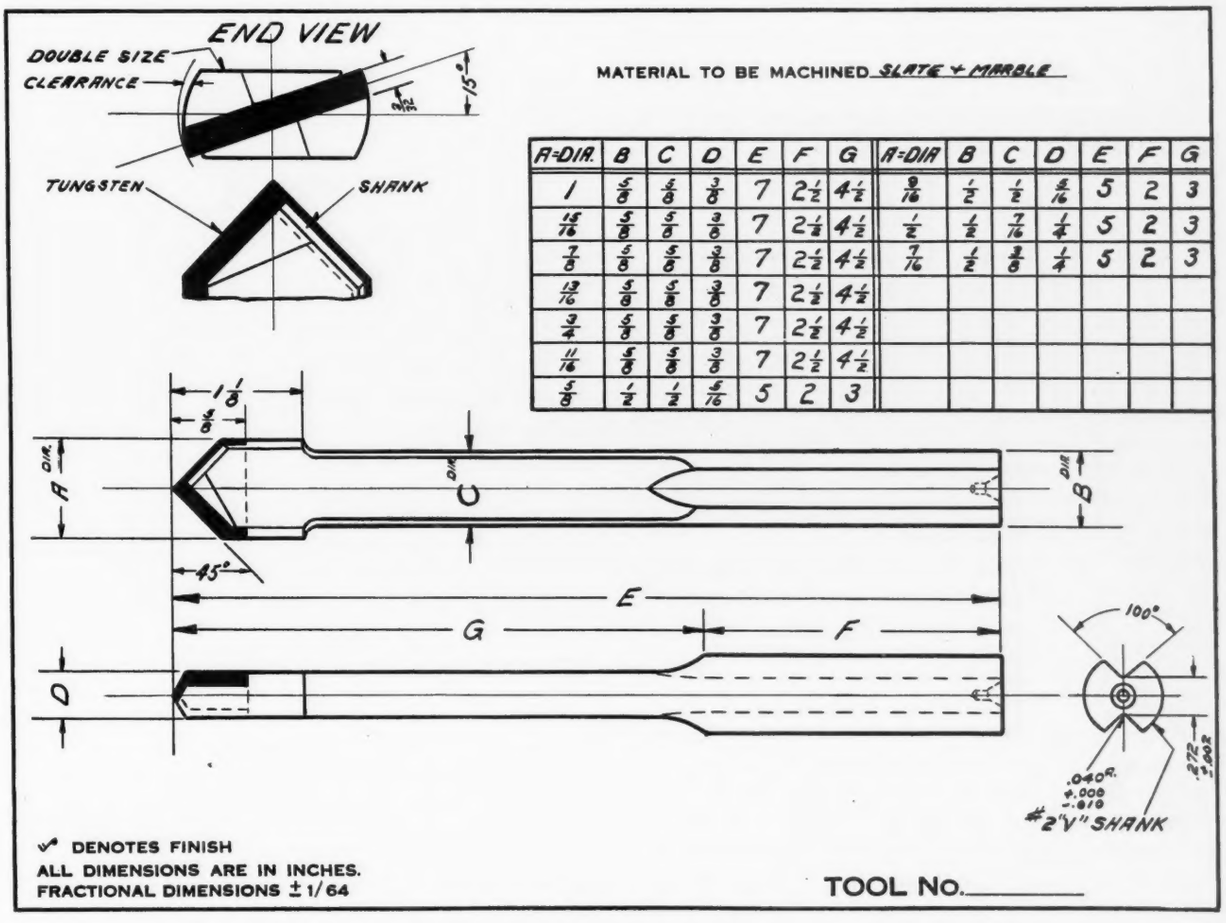


Fig. 2. Flat Type Tungsten-carbide Tipped Tool Used in Radial and Sensitive Drilling Machines for Drilling Slate and Marble

sten-carbide tipped flat drills overcome this hazard and insure perfect drilling.

In counterboring large holes in slate with high-speed steel blades of the type shown in Fig. 1, a speed of 40 to 45 surface feet per minute was considered good practice, using water for a coolant. Tungsten-carbide tipped blades made it possible to counterbore these holes at a surface speed of 150 feet per minute without using a coolant.

In the case of 4 1/8-inch counterbore blades of high-speed steel, a surface speed of 42.9 feet per minute, with a feed of 0.006 inch, was used with water as a coolant. A tungsten-carbide blade of the same size, using the same feed, was run at a speed of 155.8 surface feet per minute without coolant. The time for drilling to a depth of 1 inch with the high-speed steel blade was 3 minutes 12 seconds, as compared with 52 seconds for the tungsten-carbide cutter. The high-speed steel cutter broke down after drilling 30 holes, while the tungsten-carbide cutter drilled 180 holes before breaking down.

The tungsten carbide used for the tips of drills of the type shown in Fig. 2 is Carboloy 119 or Firthite XS. The cutting speeds range from 235 revolutions per minute for drills 1 inch in diameter to 540 revolutions per minute for drills 7/16 inch in diameter. The feed per revolution is approximately 0.025 inch for these sizes. Drills of this kind are used in radial and sensitive drilling machines without employing a coolant. The shanks for the tools are made from shank steel having a carbon content of 0.50 to 0.63 per cent; manganese, 0.60 to 0.90 per cent; phosphorus, 0.04 per cent; and silicon, 0.15 per cent.

* * *

Ohio Machinery Builder Celebrates Hundredth Anniversary

The Cooper-Bessemer Corporation of Mount Vernon, Ohio, one of the oldest builders of oil and gas engines in the United States, celebrates its hundredth anniversary this year. Two brothers, Charles and Elias Cooper, built a small iron foundry at Mount Vernon, Ohio, in 1833, thereby laying the foundation for what has developed into a large machinery building business.

The new foundry first made castings for plows, carding machines, and sawmill machinery. About 1850 the Cooper brothers built the first steam locomotive constructed west of the Alleghenies, for the Baltimore & Ohio Railroad. In the late fifties, they began to build Corliss engines, and about 1900, the company turned its attention to gas and oil engines, as well as compressors. In 1925, the manufacture of Diesel engines was begun; and in 1929, the concern merged with the Bessemer Gas Engine Co., forming the Cooper-Bessemer Corporation.

* * *

Rules that antagonize, defeat their purpose.—*The Shop Review*

Calculating Dimensions of Intersecting Cylindrical Punches

By WALTER WELLS

A much simpler formula than that given on page 273 in December MACHINERY for calculating the amount of metal to be machined off intersecting punches is given here. The writer had occasion to work out this formula some years ago when making mold dies having intersecting punches. Its simplicity made it possible to compute the values easily from the three dimensions given, namely, the punch diameters and the center distance.

It is best to use the larger punch circle as a base to work from. Separate its diameter into two factors a and b, as indicated in the accompanying diagram. Distance b represents the depth that the smaller circle "eclipses" the larger one.

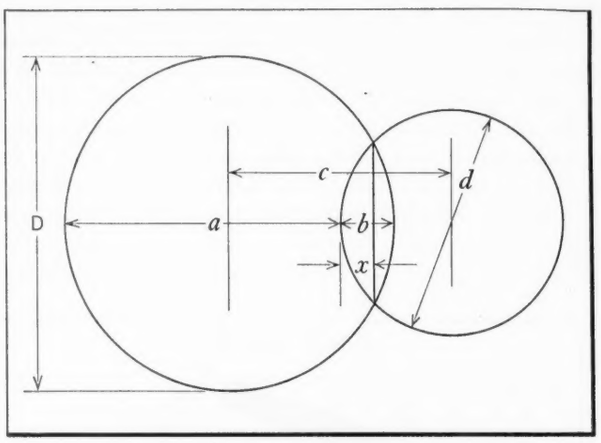


Diagram Used with Formula for Finding the Dimensions of Punches

The following formula is now used for calculating the distance x:

$$x = \frac{a \times b}{2c}$$

The actual micrometer reading for machining the larger punch equals $a + x$, and the reading for the smaller punch equals $d - x$.

Assume that $D = 6$ inches, $d = 4$ inches, and $c = 4$ inches. Then, $b = 1$ inch and $a = 5$ inches.

Applying the formula,

$$x = \frac{5 \times 1}{2 \times 4} = \frac{5}{8} \text{ inch}$$

Proceeding, $5 + 5/8 = 5\ 5/8$ inches, the dimension for checking the large punch; and, $4 - 5/8 = 3\ 3/8$ inches, the dimension for checking the small punch.

It is always good practice in this kind of work to make a sketch to scale in order to check the accuracy of the calculation. For very small punches, a careful sketch drawn to a scale of 10 to 1 will, as a rule, indicate the micrometer reading close enough without any calculations.

Important Factors in the Selection of Cutting Lubricants

Tool Failure and Poorly Finished Work are Frequently the Result of Guesswork in Selecting the Cutting Lubricant

By H. C. DECKARD

THE selection of a cutting oil depends on a great many different conditions, and the best results can be obtained only by a consideration of all the factors involved, backed up by an unbiased test. A number of the most important factors are listed in the following. No attempt has been made to arrange them in the order of their relative importance, as they are too closely allied to make this possible.

1. Type of equipment, such as lathe, drilling machine, or automatic screw machine.
2. Method of distribution of coolant, such as a central storage and pump or an individual pump and pan on each machine.
3. Kind of material to be cut.
4. Hardness of material.
5. Chemical composition of material.
6. Operation to be performed.
7. Chemical and physical qualities of the oil.
8. Cutting speed and depth of cut.

Relation of the Machining Equipment to the Cutting Lubricant

The first item in the list given of conditions governing the selection of a cutting lubricant is the type of machining equipment used. This factor is probably the least important of those listed. Demonstrators of some types of machine tools recommend certain "pet" cutting oils to the purchasers of their equipment. This is particularly true in the case of automatic equipment. On one installation of automatics, the writer was warned never to use soluble oil on the machine, as it was sure to have an injurious effect on the bearings. Having a number of hand screw machines with plain bearings producing similar parts, on which excellent results were obtained without excessive wear on the bearings, it was decided to try soluble oil on some of the automatics and a high grade cutting oil on others, in order to compare the results.

After some weeks of operation, working twenty-four hours a day, the bearings of the machines were inspected. Not the slightest difference in their condition could be detected, notwithstanding the fact that all of the machines were operated at the same cutting speed. However, the production on the machines using soluble oil was slightly higher than on those using the straight cutting oil. The writer is, therefore, of the opinion that the type of machine does not play an important part in the selection of a cutting oil. The oil that gives a certain tool life on one machine will give equally good results on a machine of a totally different type.

The second factor to be considered is the method of distributing the coolant to the cutting tool. A number of the larger manufacturers have central storage and pump systems for distributing the cutting oils to the various machine tools. This system has both advantages and disadvantages. Chief among the advantages is the elimination of belt troubles where the flow of cutting coolant is dependent on an individual pump for each machine. In addition to belt trouble, a great deal of time has to be spent in priming individual pumps after they have been allowed to stand idle for an appreciable time.

The disadvantage of the central storage system is in the difficulty encountered when changing the job on a particular machine, as the grade of coolant is likely to be unsuited for the material of which the new part is composed. Another disadvantage is that when there is any trouble with the central system, a whole battery of machines must be shut down. Failure of the system may cause a great deal of damage to the cutting tools if the trouble occurs without prompt notice to the operator.

The writer has operated with both the central and individual systems, and believes that of the two, the individual pump is the more satisfactory, in spite of belt and priming troubles. The individual pump also has the advantage of allowing a more careful selection of the coolant for the particular job. With the central system, an attempt is made to operate with one general-purpose oil and one mixture of soluble oil, which is a disadvantage.

Selecting the Lubricant Best Suited to the Metal to be Machined

The third factor governing the selection of the cutting lubricant, and one of the most important, is the kind of material to be machined. A number of manufacturers use a coolant on steel, but do not consider it of much importance on such materials as brass, bronze, and babbitt. The writer has had a great deal of experience in machining the latter materials; and they, as well as aluminum, machine much more readily, with a better finish and longer tool life, when a coolant of the proper kind is used.

For brass, bronze, babbitt, and aluminum, very good results are obtained by the use of one part of soluble oil to fifteen to twenty parts of water. The best results on bronze and brass, however, are

obtained by the use of paraffin oil. This may be used alone, although a slightly better finish is obtained by mixing one part of a good cutting oil base to twenty parts of paraffin oil. Excellent results can be obtained in drilling, boring, reaming, broaching, or diamond-boring with this mixture. It has been used in boring the bronze bearings in the piston-pin end of aircraft connecting-rods.

The crankshaft ends of these rods were babbitted and diamond-bored. Turpentine and kerosene, mixed half and half, were used for this operation. The rods passed a strict Navy inspection in every detail, the bore being held to very close limits, and the finish was excellent. The turpentine-kerosene mixture is recommended in some cases for use on aluminum, although excellent results are obtained with soluble oil. A mirror-like finish and excellent tool life result with the soluble oil, when proper clearance and rake are given to the tool.

The various steel alloys require careful blending of the cutting solutions to secure the best machining results. The plain low-carbon steels machine readily with the use of a ten-to-one mixture of soluble oil. The only difficulty that would be experienced with this mixture would be in threading on automatics.

The Life of Tools Used in Cutting Hard Metals can be Increased by Using the Proper Coolant

The fourth factor for consideration is the hardness of the material to be machined. Obviously, the harder the material, the shorter the tool life and the more exacting the cutting oil requirements.

In cutting unusually hard metals, it is good policy to start with a good base oil, diluted with four parts of paraffin oil to one of the base oil. Then keep adding base oil until the maximum tool life is secured. In performing threading operations on material of this kind, it will be found of value to subject the high-speed steel cutter to a cyanide draw at 1050 degrees F. for thirty minutes.

The Chemical Composition of the Metal also Affects the Cutting Properties

The fifth factor to be considered, namely, the chemical composition of the material to be machined, is closely allied to the two preceding factors. This is particularly true with reference to steel. The chemical composition has a distinct bearing on the heat-treatments necessary to secure the required physical characteristics. The higher the sulphur content in any steel, the more free cutting is the material; hence, the less exacting the requirements for a cutting oil.

How the Operation Affects the Choice of Coolant

The type of operation to be performed must be considered in connection with the kind of material in selecting the coolant. Fairly successful results have been attained in performing all types of operations on screw stock with soluble oil as a coolant. In threading this metal within close limits, however, better tool life and finish are obtained by a good straight cutting oil. Good results can also be obtained on most of the alloy steels by the use of soluble oil.

However, for threading and higher cutting speeds, a good grade of cutting oil is absolutely necessary for these metals. For turning and reaming, as well as drilling and milling, a solution of one part of base oil to four parts of paraffin oil will give excellent results, even on very tough, hard alloys. For threading, very good results have been secured on nickel, chrome-nickel, and chrome-vanadium alloy steels by the use of one part of base oil to three parts of paraffin oil.

Relation of Cutting Speed and Depth of Cut to the Type of Coolant Used

Last, but not least, of the factors to be considered in selecting a coolant is the cutting speed and depth of cut. The heat generated on the cutting edge of the tool is in proportion to these factors. The cutting speed is controlled largely by the depth of the cut. A cutting speed that can be maintained with a depth of cut up to 1/8 inch may have to be greatly reduced when the depth of cut is increased to 1/4 or 1/2 inch, or more.

The function of a cutting oil is to increase tool life and improve the finish on the work. The selection of a cutting oil, for heavy cuts especially, should be determined by the cooling quality of the oil. This is true for any type of machining operation, but when the depth of cut or the cutting speed is increased, this quality of the oil is a great deal more necessary. It is essential to conduct the heat generated at the cutting edge away as rapidly as possible. In fact, the maximum cutting speed and depth of cut are determined by the ability of the cutting oil to perform this function.

* * *

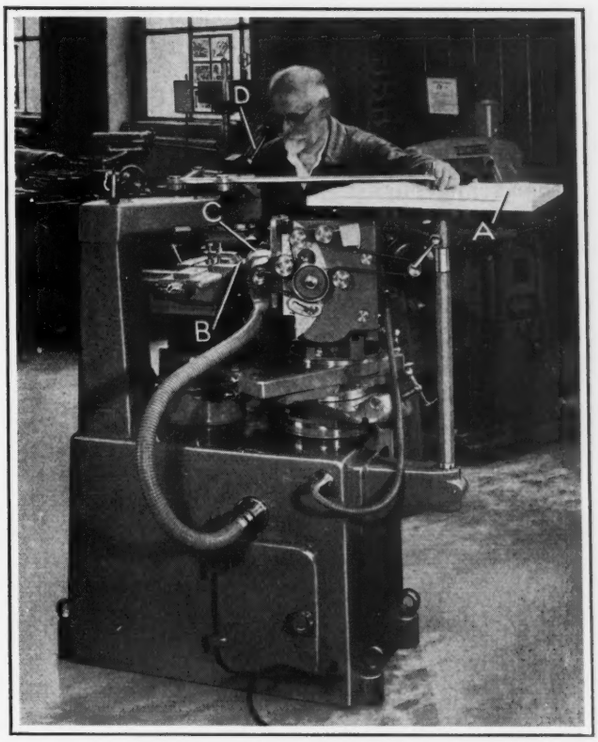
A Welding Repair Job that Saved Nine Hundred Dollars

Recently a direct expense of $900 was saved by repairing the 30,000-pound rocker arm of a large vacuum pump by bronze-welding. Because of the pump construction, says *Oxy-Acetylene Tips,* it was absolutely necessary that the casting to be welded be kept in exact alignment with adjoining bearings. The casting was 14 feet long by 24 inches wide, and was broken completely across the arm. The thickness of the metal ranged from 1 1/2 to 3 inches. The actual welding work required about 7 1/2 hours. The total welding cost, including preparatory work, labor, and material, amounted to less than $100. It would have cost at least $1000 to replace the casting, and it would also have taken a longer time.

Profile Grinding Machine for Tools and Gages

Profiles are Ground Accurately to Shape from Scale Drawings Fifty Times Actual Size on a Newly Developed German Machine

By OLIVER P. van STEEWEN, Berlin-Steglitz, Germany



THE accuracy and speed with which profiles can be ground on a machine developed recently by Loewe Gesfürel of Berlin, Germany (represented in the United States by George Scherr Co., 128 Lafayette St., New York), are attributed principally to the unique profile-copying system used. This system consists primarily of a pantograph having a stylus or needle attached to the long arm and a microscope attached to the short arm. The microscope is equipped with cross-hairs and magnifies thirty times. The pantograph has a ratio of 50 to 1. The grinding wheel, its adjusting slides, and reciprocating mechanism comprise a unit of the machine that is entirely separate from the pantograph and is operated by separate controls.

How the Profile-Copying System is Used

In grinding the profile of a gage or forming tool, an accurate scale drawing of the profile, fifty times the actual size, is mounted on the table of the machine, as shown at *A* in the heading illustration. The work to be ground is clamped on the table at *B*. The drawing *A*, work *B*, and the slide carrying the grinding wheel *C* are properly adjusted or positioned, after which the grinding proceeds in the manner to be described.

The needle of the pantograph is placed firmly on the starting line on the profile drawing. This line is exactly parallel with the starting edge on the upper work-slide. Next the wheel-slide, with its vertical up-and-down traverse movement, is fed slowly forward by hand until the ground edge on the work appears to be exactly in the center of the cross-hairs in the microscope *D*. At this point the position of the ground edge corresponds exactly with that of the needle on the large-scale drawing.

The needle is next moved along a little farther on the profile line, and the grinding wheel fed forward again by means of the wheel-slides until the ground edge appears in the center of the cross-hairs. This operation is repeated until the entire profile has been ground to shape. As the

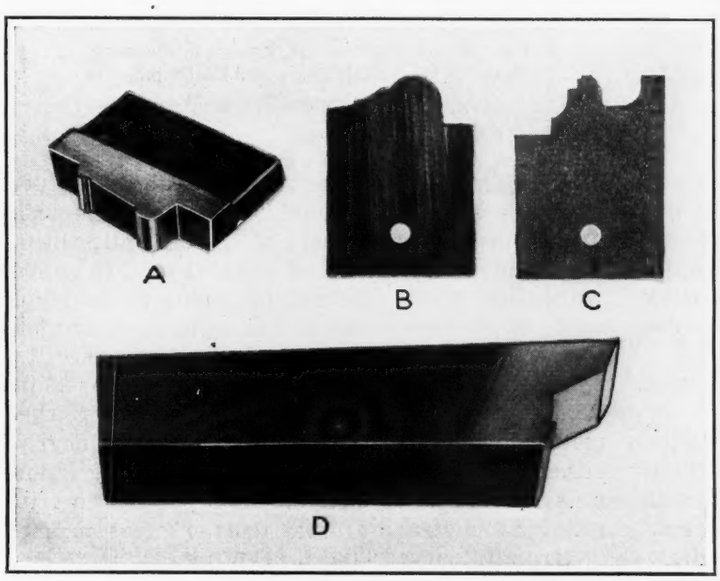


Fig. 1. (A) Scraping Cutter for Making Profile Tools for Forming Roller Bearings. This Cutter was Ground to Shape on the Machine Shown in the Heading Illustration in Six Hours. (B) Gage for Gun Part Formed on Profile Grinding Machine in Four Hours. (C) Typewriter Part Gage Ground to Shape in Four and One-half Hours. (D) Relieving Tool Finished to Shape in Five Hours

movements of the pantograph and the grinding-wheel slide are entirely independent, wear on the grinding wheel can be disregarded.

Features of Work-Holding Slides

The arrangement for clamping work is shown in the heading illustration and in Figs. 2 and 3. A section of the surface of the work, 0.4 inch square, can be ground without changing the position of the work. This section corresponds to a section 20 inches square on the enlarged scale drawing. After the profile grinding has been done on the surface that can be ground with the work in one position, the work-holding slides are reset to bring a new section of the work into the grinding area. Measuring gages located in the hollows of the work-slides, as shown in Fig. 3, are used in resetting the work. These gages, under constant pressure, act on dial indicators through feeler pins.

The work can be lighted up by electric lights on the top and bottom, the top lights being nearly colorless and the lower lights green. With this arrangement of lights and with the work magnified thirty times by the microscope, the outline of the profile stands out very distinctly, so that it can be accurately centered under the cross-hairs. When a drawing for a complete profile would cover a sheet larger than 20 inches square, the profile is divided up into sections of this size. The profiles for these successive sections are then drawn on one sheet, one above the other. It is a simple matter to change the position of the work-table to suit the different positions of the profile sections on the drawing by using the gages and dial indicators shown in Fig. 3.

Details of Grinding-Wheel Slides

The grinding wheel *C* and the wheel-spindle, as well as the driving motor, are mounted on special slides. The swivel base of the lower slide permits it to be swung around 90 degrees to the right and 90 degrees to the left of the central position. The middle slide can be set parallel with the upper work-slide, and it can also be swung to any angle up to 90 degrees either to the right or to the left. For relieving form cutters on the front face, the wheel-slide can be tilted to any angle up to 35 degrees. The driving box carrying the grinding wheel can be inclined in a horizontal guide 10 degrees either to the right or the left for grinding lateral relief. These adjustments make it possible to grind relieved and straight profile tools or gages made up of straight, curved, and broken lines.

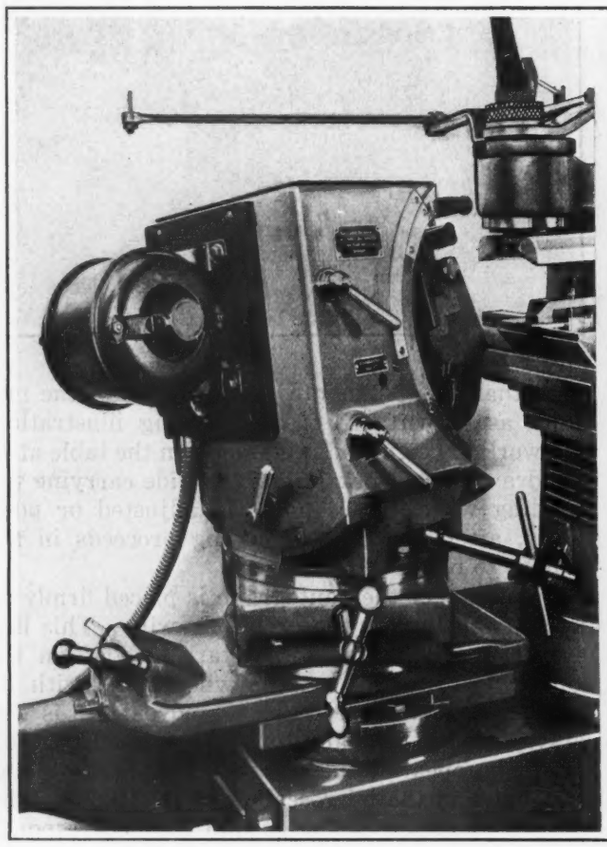


Fig. 2. Profile Grinding Machine with Wheel-head in Oblique Position for Grinding Side Clearance on Formed Tools

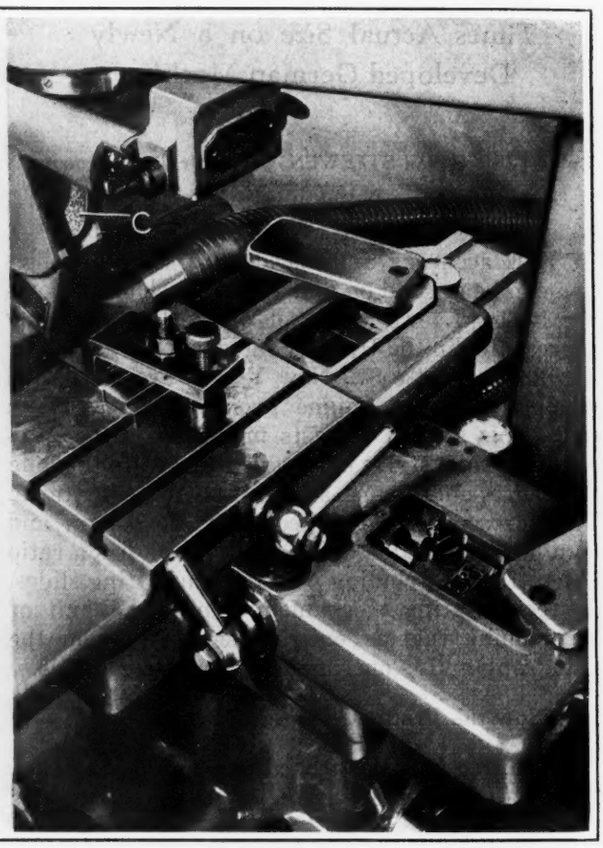


Fig. 3. Work-head of Profiling Machine, Showing Measuring Gages and Dial Indicators Used when Grinding Large Work

The up-and-down movement of the wheel-spindle carrier is obtained by a drive from the motor which drives the grinding-wheel spindle. The stroke can be regulated to suit the thickness of the work. The number of strokes per minute is 80 for pieces up to 3/4 inch thick, and 40 for pieces from 3/4 to 1 7/8 inches thick.

In addition to profile grinding, the machine can also be used for making accurate drawings of the profiles of gages and tools to a scale of 50 to 1 by reversing the process described.

* * *

Selecting the Proper Lubricants for Ball and Roller Bearings

Operating temperatures play a very important part in the selection of a lubricant, since the viscosity of oil and the body or consistency of grease decrease rapidly under the influence of heat. The accompanying tables, furnished by K. A. Newman of the research staff of E. F. Houghton & Co., Philadelphia, Pa., are based on wide experience in providing lubricants for anti-friction bearings of industrial equipment. These tables show the approximate viscosity of oil and the consistency of grease to use under any ordinary combination of load, speed, and operating temperature.

Table 1. Viscosity of Oils Recommended for Bearings Operating at Different Temperatures under Various Speed and Loading Conditions

Operating Temperature of Bearing, Degrees F.	Normal Loads and Speeds	Normal Loads and High Speeds	Heavy Loads and Normal Speeds
	Saybolt Viscosity of Recommended Oil at 100 Deg. F.		
0– 32	100*	82*	100*
33– 60	100*	82*	120*
61– 95	105	82	160
96–125	160	100	400
126–150	530	400	700
151–180	945	530	1500
181 and over	Steam Cyl. Oil	1500	Steam Cyl. Oil

*These oils should have a cold test of not less than −35 degrees F.

* * *

Experiments have recently been conducted on the Victorian Government Railways in Australia to ascertain whether motor tractors converted for use on rails can be advantageously employed for light haulage on branch lines. A tractor fitted with a gear-box to give speeds up to twenty-five miles an hour has given satisfactory results. The operating cost of the tractor is said to be only one-sixth of that of a steam locomotive.

Incorrectly Installed Belts are Costly

By W. F. SCHAPHORST

I have frequently observed that when $1000 is spent for mechanical equipment, installation directions are carefully followed and an expert is usually employed to do the work; but when the same amount is spent for belting, it is not an uncommon practice to allow almost any mechanic to do the installing. True, it is not necessary to have a college education in order to install belts, pulleys, and shafting correctly; but there is more to it than merely cutting the belt, punching holes, and then lacing. One thousand dollars' worth of belting can be ruined in a surprisingly short time if the shafts are not parallel, if the pulleys are not correctly aligned, if the belt is not cut to the right length and square across, and if the joint is not properly cemented or laced.

Novices should not be permitted to install belts, for the same reason that they are not allowed to install important machinery. There should be no guesswork about how long a belt should be cut. After a belt is once cut too short, it cannot be easily lengthened. It may be better to cut a belt too long, but why not cut it "just right"? Cemented belts must, of course, be cut longer than laced belts. Many thousands of dollars' worth of belting has been destroyed by non-thinking belt installers who cut the belt too short and then "stretch" it to make the ends meet.

If a belt is too tight when first placed on the pulleys, it will be ruined by over-stressing. Bearings sometimes get hot owing to tight belts. Much power may be lost because of excessive tightness and the resulting sprung shafts. In cutting the belt, unless the belt is cut "square across," using a square, the belt will not run evenly and there will be greater stress on the short side than on the long side. The short side, therefore, is weakened first. Uneven running is a common cause of the belt running off, and belts that continually run off are usually short-lived. Shafts out of parallel and poorly aligned pulleys also are common causes of belts running off.

Knowledge of belting is easily acquired. Before allowing a man to cut up good belting, be sure that he knows the rudiments of belt installation.

Table 2. Consistency of Greases Recommended for Bearings Operating at Different Temperatures under Various Speed and Loading Conditions

Operating Temperature of Bearing, Degrees F.	Normal Loads and Speeds		Normal Loads, High Speeds		Heavy Loads, Normal Speeds	
	Consistency	Melting Point, Degrees F.	Consistency	Melting Point, Degrees F.	Consistency	Melting Point, Degrees F.
0– 30	Soft	150	Soft	150	Soft	150
31– 75	Soft	150	Soft	150	Soft	150
76–100	Medium	160	Medium	160	Medium	160
101–150	Medium	250	Medium	250	Hard	300
151–170	Hard	300	Hard	300	Extra Hard	350
171 and over	Steam Cylinder Oil		Steam Cylinder Oil		Heavy Steam Cyl. Oil	

A Weather Bureau for the Nation's Industries

A Few Thoughts on the Subject of Inter-Industry Planning and on the Objections Raised to it

By L. M. WAITE,* South Norwalk, Conn.

THIS article is the third of a series dealing with inter-industry planning and its relation to a constructive program of concerted action for preventing serious industrial depressions and periods of widespread unemployment. (The preceding articles were published in MACHINERY, November, 1932, page 215, and January, 1933, page 344.) In the present article, the author makes a comparison between the Weather Bureau and a possible service that would record industrial and financial conditions and foretell their probable effect. The theory involved is that unemployment, like any organic ailment, can be most successfully attacked in its early stage.

It should be just as feasible to record and publish forthwith, through a properly organized agency, all developments and changing conditions in business activity and employment, and to warn of dangerous trends in credit, expansion, or available stocks, as it is for the Weather Bureau to predict weather conditions throughout the country.

It should be just as possible for American business men to have authoritative E. C. E. S. (employment, credit, expansion, available stocks) reports weekly, applying to individual industries, as well as to national business conditions as a whole, as it is to have nation-wide weather reports, which form a determining factor in many activities.

In comparing the benefits from the two types of service, there is one fundamental difference that is favorable to the business reports: (1) The Weather Bureau searches the *secrets of nature* in order to make it possible to prepare against the consequences of an approaching storm, but it leaves us quite awe-stricken and helpless as to the control of even a single element of the storm itself. (2) An organized E. C. E. S. service, operated with the object of *guiding human judgment,* should enable us to alter the direction of a business storm, confine it to restricted areas, and, possibly, dissipate it entirely.

It is certain that many activities and ventures would be launched under more favorable conditions than they often are, were such a business service in operation, just as we avoid much damage and disappointments by making use of the service that the Weather Bureau provides.

Objections Raised to a Comprehensive Business Condition Announcement Service

It has been remarked that the proposed E.C.E.S. service could not possibly be kept out of politics. If the Weather Bureau can be kept out of politics, why not a Business Report service?

Few of us start outdoor activities, whether they are related to pleasure or to business, especially if they are of some importance, without consulting the weather reports. The value of the weather reports is so generally recognized that we quickly note inaccurate predictions, and certainly would loudly disapprove of any political interference with this service.

The proposed E. C. E. S. service would have to be equally reliable and be based upon the same accurate recording of established facts. Since such a service, when established, would be the most essential factor in the entire organization of business, it is difficult to conceive that business, industry, and consumers would submit to political interference without raising objections of a very decided nature to any such meddling.

All Progress Has Become Successful through Experimentation

A service such as suggested cannot be planned to perfection in advance. It cannot be expected to prove successful in every detail as soon as it is put into operation. Experiments, adjustments, and changes will be necessary—nor will they be entirely painless. To say that this is a poor time for experimentation implies that in order to make an experiment successful, it must be made when we are so busy with something else that time is not available to properly think out and develop new ideas. A period of business inactivity is the very best time for planning and experimenting with new ideas, whether they pertain to mechanics or management.

Unfortunately, there are today only very feeble and sporadic efforts being made to find a permanent solution to the problem of business instability and unemployment. There are too few men of leadership who have the vision and courage to propose methods like the Swope Plan. The great majority of men engaged in business and industry view business depressions and unemployment with the same feeling of awe and helplessness that they experience in watching a devastating storm.

During the last three years, we have been inclined merely to ask, "What is the matter with business?" rather than to devote concerted energy and courage to a possible solution of the problems underlying our difficulties.

Our very inactivity in matters of price cutting and the lack of serious effort, except in a few industries, to establish rational cost policies, show the need for some agency that can assume leadership in regard to essential business policies of widespread importance.

*Author of "You, Me, and Business"

In production we provide, in our "overhead," an item to meet the cost of idle equipment hours, and we cover that cost in the selling price; yet we are prone to accept the statement of a high insurance authority that "there can be no sound provision for the insurance of idle man-hours."

We know, however, that there is a definite value to a corporation in maintaining its organization and in having at its command individual members of proved ability. It has been considered a sound expense to build up and disburse a fund for making available the services of individuals whose entire effort may not be required for the moment. The unemployment reserve proposals in the Swope Plan, for example, are merely an extension of this policy, which, to some limited extent at least, is applied by practically every employer in periods of dire emergency such as the present.

It has been said that "any plan that provides even a partially sustained purchasing power through payment for services not actually rendered is a form of dole." This statement does not check with the findings of a considerable number of corporations who have been experimenting with plans for maintaining the purchasing power of employes in times of depression.

The Problem of the Older Worker

Age discrimination has been spoken of as "an unavoidable element of employment." If there is such a thing as human obsolescence, it is reasonable to assume that industry will have to take account of it in somewhat the same way as it takes account of equipment obsolescence. Again, the Swope Plan makes a proposal for taking care of the problem of human obsolescence. Without doubt, this problem can be solved to much better advantage by business and industry than by a political party; and since it is almost certain that sooner or later the politicians will find it advantageous to tackle this problem, it would be in the interest of all, if business would take action before party lines establish a battle-front and introduce endless complications.

During recent years, it has been convenient to blame the World War for all political, business, and industrial difficulties, but many of these problems were with us long before the War. The problem of business instability and unemployment has been repeated with periodic accuracy. To blame it on the War will not solve it. We need an agency of *foresight;* if not, periodic unemployment will continue to be the price of *hindsight.*

New Developments in Cast Die and Tool Steels

During recent years several improved die and tool steels have been placed on the market. Among the earliest of these was the cast-to-shape alloyed air-hardening tool steel known as "P R K-33 Cobaltcrom." This steel, covered by a United States patent, has the following approximate composition: Carbon, 1.50 per cent; chromium, 13 per cent; cobalt, 3.50 per cent; molybdenum, 0.85 per cent; and small percentages of nickel, manganese, and silicon. Castings of this steel are made by the Detroit Alloy Steel Co., Detroit, Mich., under an exclusive license from Darwin & Milner, Inc., Cleveland, Ohio, American division of Darwin's, Ltd., Sheffield, England.

This steel is used in the cast condition without forging. It is subjected to a heat-treatment previous to machining, and is subsequently hardened. The advantages of this steel are its ability to resist the abrasive action encountered in the forming, drawing, and blanking of sheet metal, and its reduced cost, due to the possibility of casting the die or tool to shape with only a minimum of machine finish. This steel is particularly useful for quantity production, because of long die life.

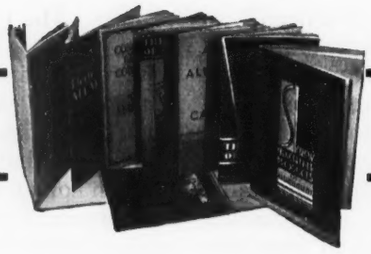
Other steels made by the Detroit Alloy Steel Co. are known as Martin Steel, Castaloy, and Carbomang. Martin Steel is made from an imported Swedish iron base with a high-carbon, high-chromium content. This steel is intended primarily for pressed-metal dies and is recommended for quantity production. Castaloy tool-steel castings can be economically used for the larger sizes of dies which were formerly made from cast iron or from a combination of cast iron with forgings or steel inserts. This steel is used for medium production requirements. The dies made from this steel are cast to shape. They find application in the drawing of light sheet metal for automobile bodies, chassis stampings, and cooking utensils.

Carbomang is an oil-hardening steel from which tools are cast to shape for purposes for which the higher-priced alloy tool steels may not be required.

* * *

New Standard for Air Chuck Cylinders

A new American standard for rotating air cylinders and adapters has been approved by the American Standards Association. It has been developed by the Technical Committee on Chucks and Chuck Jaws working under the sponsorship of the American Society of Mechanical Engineers, the National Machine Tool Builders' Association, and the Society of Automotive Engineers. The standard has been developed to obtain interchangeability of different makes of air cylinders on the spindles of machine tools without changing the adapter or draw-rod. Detailed information, giving dimensions and specifications of rotating air cylinders and adapters made in accordance with this standard, is obtainable from the American Standards Association, 29 W. 39th St., New York City.

NEW TRADE  LITERATURE

MECHANICAL RUBBER GOODS. B. F. Goodrich Rubber Co., Akron, Ohio. Loose-leaf circular illustrating the application of Goodrich rubber pulley lagging, the purpose of which is to increase the coefficient of friction between a rubber belt and the pulley face. The bulletin also contains data on elevator bucket washers. Loose-leaf circular descriptive of "Armorite," a soft elastic black rubber used to protect surfaces from the abrasion of wet or dry materials. Four-page insert for the Goodrich Mechanical Goods Catalogue, dealing with the Maxicon general-service conveyor belt and the improved hot material belt.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletin GEA-383D, descriptive of low-speed alternating-current generators. Circular GEA-1145B, illustrating and describing GE steam turbines for the mechanical drive of pumps, fans, compressors, blowers, pulverizers, stokers, and paper machines. Bulletin GEA-1520A, descriptive of electric heating units and devices. Circular GEA-1618, discussing the building of motors and control into machine tools.

POWER-TRANSMISSION EQUIPMENT. Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. Data Book 1457, on Link-Belt Silverlink roller chains. The object of the book is to assist in the proper selection and application of finished-steel roller chains and wheels for the fields of usefulness to which they are best adapted. It tells how to figure, apply, install, lubricate, and maintain roller-chain drives. There are 71 pages listing complete drives available from stock.

LATHES. Rivett Lathe & Grinder Corporation, Brooks St. and Riverview Road, Brighton, Boston, Mass. Bulletin 608-B, describing in detail the Rivett 608 precision back-geared screw-cutting lathe. The various attachments for grinding, relieving, traverse milling, spiral milling, thread milling, dividing, etc., are illustrated and described, and tables of specifications and lathe spindle speeds are included.

Recent Publications on Machine Shop Equipment, Unit Parts, and Materials. Copies Can be Obtained by Writing Directly to the Manufacturer.

CUTTING-OFF MACHINES. Andrew C. Campbell, Inc., Bridgeport, Conn. Circular descriptive of the "Hudorkut" submerged cutting machine, which is designed to operate with the work immersed in a bath. The advantages of this process are pointed out, and specifications of the machine are given.

COPPER AND BRASS PRODUCTS. American Brass Co., Waterbury, Conn. Publication B-21, descriptive of Anaconda beryllium copper, a heat-treatable copper alloy. The bulletin shows how a marked improvement can be effected in the physical properties of this metal by heat-treatment.

GEAR-CHAMFERING MACHINES. City Machine & Tool Works, E. 3rd and June Sts., Dayton, Ohio. Circular entitled "Seventeen Paying Guests in the Plant of an Automobile Manufacturer," illustrating an installation of seventeen Peerless gear-chamfering machines in an automobile plant.

BROACHES. Colonial Broach Co., Detroit, Mich. Catalogue B-62, covering the Colonial line of high-speed broaches and ground-form spline broaches. Some outstanding applications of these tools are illustrated, and complete specifications for the various sizes are given.

X-RAY EQUIPMENT. Adam Hilger, Ltd., 98 Kings Road, Camden Road, London, N. W. 1, England. Publication No. 173/2, descriptive of the X-ray metallurgical crystallograph for the X-ray examination of the effects of heat and mechanical treatment on metals.

OPTICAL EQUIPMENT. E. Leitz, Inc., 60 E. 10th St., New York City. Bulletins 2 and 3, describing, respectively, Darkfield microscopy for the micro-analysis of metals, and a simplified model of the Leitz micrometallograph, with photomicrographic camera.

AUTOMATIC WIRE-WORKING MACHINERY. Sleeper & Hartley, Inc., Worcester, Mass. Loose-leaf catalogue covering spring-making machinery, armoring machinery, continuous wire-drawing equipment, wire-nail machinery, and wire mill equipment.

LUBRICANTS. Acheson Oildag Co., Port Huron, Mich. Technical bulletin No. 200.2, entitled "The Mechanics of Lubrication with Colloidal Graphite," telling why the addition of colloidal graphite to ordinary lubricants increases their efficiency.

SMALL TOOLS. O. K. Tool Co., Inc., Shelton, Conn. Bulletin illustrating the wide application of the O. K. cutter blade to combination tools for core-drilling, reaming, boring, counterboring, facing, hollow-milling, and trepanning.

OPTICAL INSTRUMENTS. Gaertner Scientific Corporation, 1201 Wrightwood Ave., Chicago, Ill. Catalogue L-1, covering the line of spectroscopic instruments made by this concern for use in both educational and industrial laboratories.

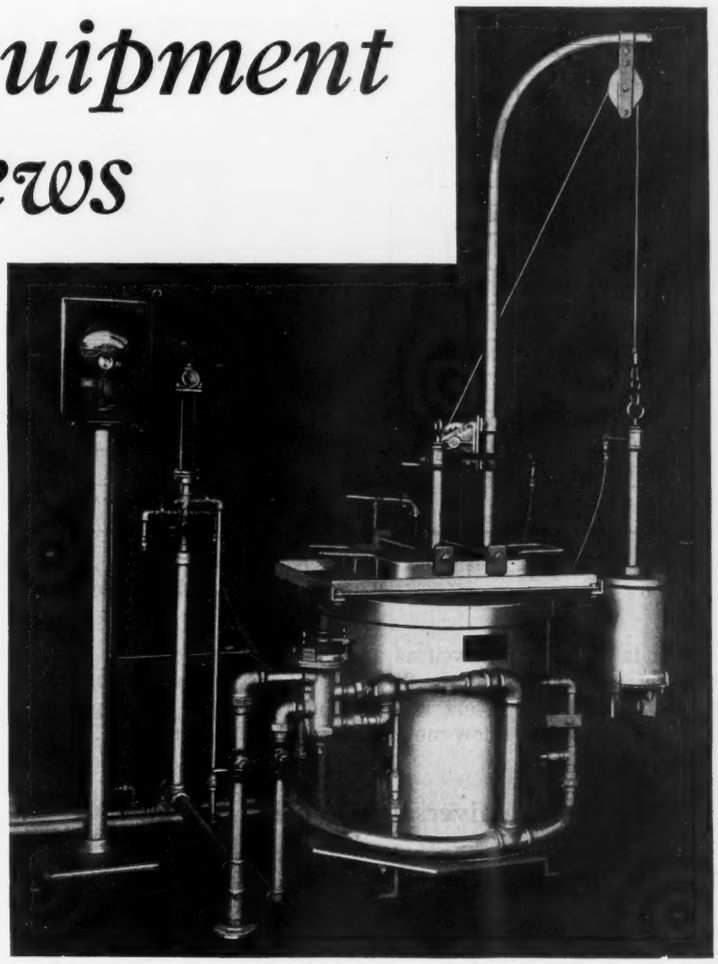
RUBBER MOUNTINGS. Lord Mfg. Co., Erie, Pa. Bulletin No. 100, illustrating and describing bonded rubber shear-type mountings for absorbing vibration in machinery and equipment of all kinds.

ELECTRIC CONTROL EQUIPMENT. Monitor Controller Co., Baltimore, Md. Circular descriptive of the application of electric control equipment in a laundry for driving a group of ten washing machines.

MOTORS. Ohio Electric Mfg. Co., 5900 Maurice Ave., Cleveland, Ohio. Bulletin E, describing the Ohio improved capacitor type motor for refrigerator service.

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts and Material-Handling Appliances Recently Placed on the Market



American Bell-Type Retort Furnace

Many manufacturers have learned during the current business depression that their large furnaces, having been designed primarily for high production, do not lend themselves to economical production on a reduced schedule. It is because of this that in some locations, the heat-treating equipment of large plants is idle, while small commercial heat-treaters are working day and night.

This condition has led the American Gas Furnace Co., Elizabeth, N. J., to develop a bell-type retort furnace, designed for both the large manufacturer and the small jobbing shop or tool-room. This furnace has been termed "The New Universal Heat-Treating Tool," because it is adapted for carburizing, nitriding, bright annealing, etc., in gaseous atmospheres and also for hardening, normalizing, annealing, and tempering. Batteries of these furnaces can be installed in large plants to meet high-production requirements and when conditions necessitate, one or more of the furnaces can be shut down. It is claimed that this advantage more than compensates for slightly increased labor charges.

Flexibility of use is the main feature of the furnace, as a nitriding charge may follow a carburizing one and so on. The case depth from charge to charge can be varied at will, and the temperature can also be changed as desired. Various ways in which the work can be placed in bells for the furnace operations are indicated in Fig. 1. Operations can follow each other without delay if two or three spare bells and bases are available.

Quenching direct from the furnace can be accomplished either by removing the bell and allowing the work to remain on the base in the furnace, removing it individually for quenching, or by elevating the base and work slowly, as shown in the central diagram of Fig. 1, for quenching in a jig, fixture, or quenching machine. When comparatively slow cooling is satisfactory, the bell with its base and work can be removed from the furnace and air-cooled or placed in a pit or an insulated can for relatively slow cooling. The bells may be of any shape to suit the work. It is claimed that uniform results are obtained because the retort is entirely enclosed in the furnace. In carburizing operations, the spent gases escape from the bottom of the bell and are consumed in the furnace.

The equipment shown in the heading illustration is of a small size. An automatic temperature

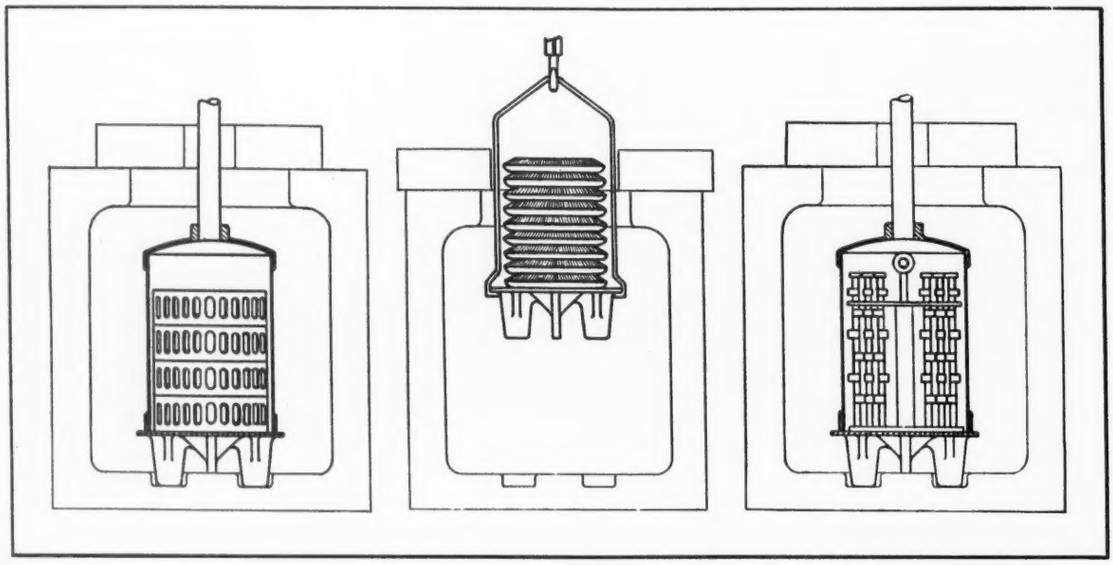


Fig. 1. Diagrams Showing how the Work Bases and Bells Seat in the New American Retort Furnace and how They are Removed

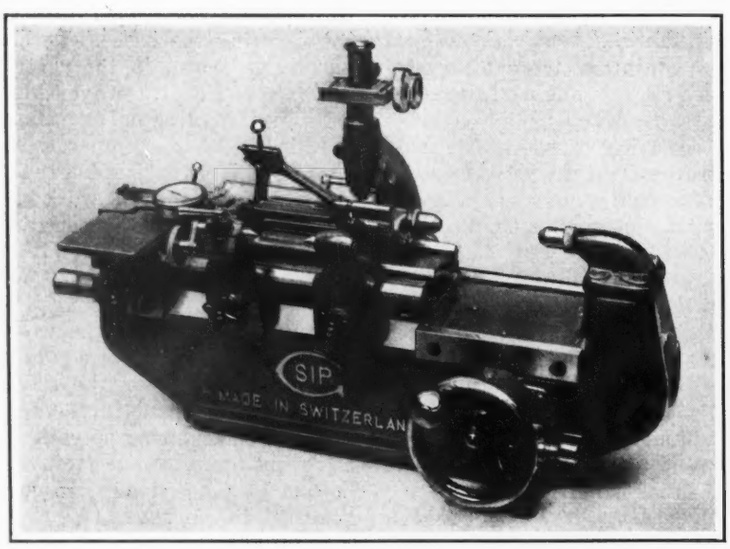
control is provided, as well as a flow meter for checking the flow of gas through the retort at all times. Two or more flow meters can be supplied when gases are to be mixed for passing through the retort or for applying the Machlet Ni-Carb-Case.

Small Universal Measuring Machine

A universal measuring machine having a capacity of 4 inches or 100 millimeters has been developed by the Societe Genevoise d'Instruments de Physique, Geneva, Switzerland, and is being made available in America through the R. Y. Ferner Co., 1127 Investment Bldg., Washington, D. C. The machine can be supplied for reading to an accuracy of 0.00005 inch, or 0.001 millimeter.

This machine is intended for such operations as checking plug gages, both for diameter and roundness; measuring the pitch and three diameters of thread gages; determining the gap length of snap gages; inspecting the pitch, diameters, and relief grinding of taps; and checking the calibration of calipers, micrometers, etc., having either spherical ends or parallel faces.

The measurements are determined by means of a micrometer microscope through which the calibrations of a glass scale are observed. A constant measuring pressure is insured by means of a spring having an indexing feature. The machine has a fixed contact anvil at each end. A slide between the two, which rolls on steel balls, carries movable anvils and the glass scale.



Measuring Machine with Micrometer Microscope for Checking to within 0.00005 Inch

Toledo Vibrator Filling Machine

An interesting new machine known as a vibrator filling machine has recently been developed by Toledo Precision Devices, Inc., Toledo, Ohio, for packing such products as nails, pins, washers, nuts, etc. This new device controls the automatic feed of materials from supply bins to scales which automati-

cally weigh out a predetermined amount of material for each package.

The new equipment consists of a scale of great accuracy, an electric-eye cut-off attachment, and a vibrator which holds the articles to be packed. The equipment can fill as many as two hundred 1-pound containers in an hour with a tolerance as close as 1/64 ounce. The accuracy of the scale makes it possible to guarantee the number of articles packed in a case, in instances when these are sold by number.

tested. The specimens need not be of a special construction.

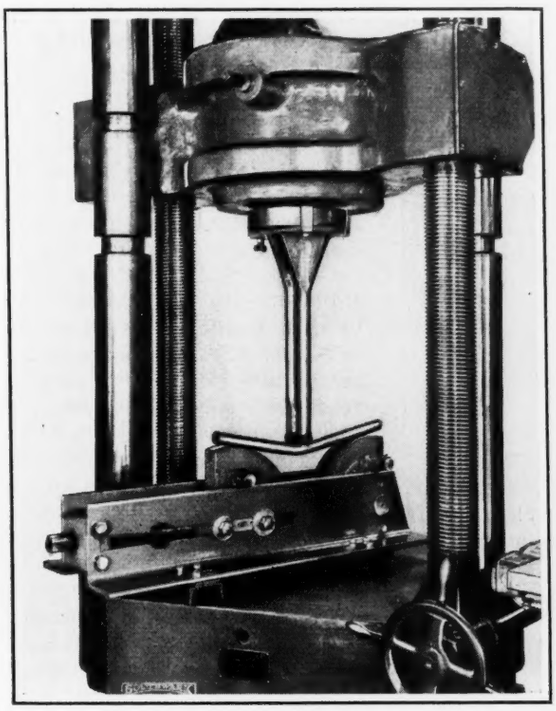
This device is adaptable to any testing machine having facilities for compression testing. Its total weight is 175 pounds.

McKinney High-Speed Saw Operated Pneumatically or Hydraulically

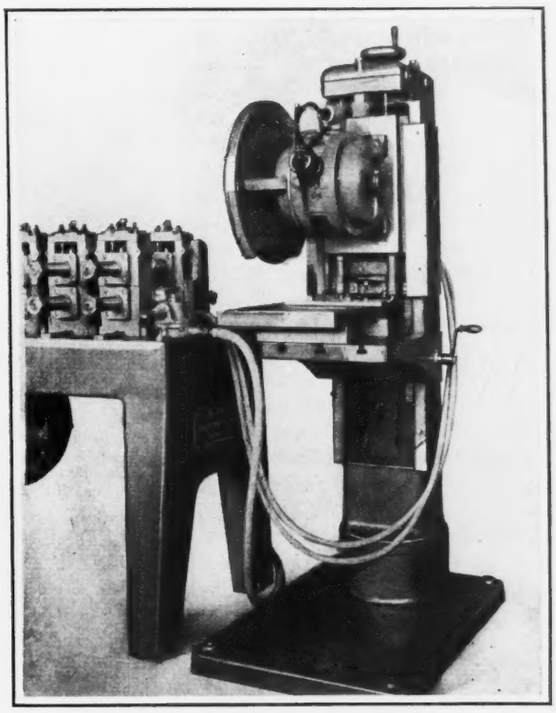
The standard feed of a cut-off saw recently brought out by the McKinney Tool & Mfg. Co., 1688 Arabella Road, Cleveland, Ohio, is 1 inch per 0.1 second. This feed is desirable for many cutting operations. However, the feed can easily be adjusted to a slower rate should the character of the work demand it. While the saw was developed primarily for use in conjunction with metal strip rolling machines, it can also be employed by itself for cutting tubing and structural shapes having a section thickness up to about 1/4 inch. Shapes up to 2 1/2 inches high can be handled.

The 18-inch saw is mounted directly on the shaft of a five-horsepower motor, which runs at 3600 revolutions per minute. The saw slide is fed up and down through an air or hydraulic cylinder located in the column, the movements of the slide being controlled through a hand-operated valve. The stroke of the saw slide is 3 inches, and this movement can be obtained at different heights by adjusting the saw head. There is also an adjustment for the table.

The column can be swung around on the base for cutting stock to an angle or for removing the saw from the line of production.



Cold-bend Testing Device Applicable to Any Machine Arranged for Compression Testing



McKinney Cut-off Saw with a Feed of One Inch in One-tenth of a Second

Cold-Bend Testing Device

A cold-bend testing device, developed by Professor C. H. Scholer of the Kansas State College of Agriculture, has been added to the line of materials testing equipment made by the Baldwin-Southwark Corporation, Philadelphia, Pa. This device is designed to bend test bars with the least possible force and without introducing lateral stresses. The speed of the test is controlled and short specimens can be

Imperial Tube Couplings

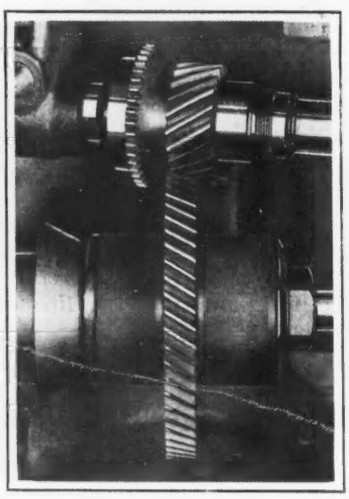
Couplings intended for use with copper, aluminum, steel, Monel, Shelby, Bundyweld and Everdur tubing have been placed on the market by the Imperial

Brass Mfg. Co., 1216 W. Harrison St., Chicago, Ill., under the trade name of Hi-Duty. These couplings are suitable for tubing installations on automobiles, trucks, tractors, airplanes, air compressors, and machine tools.

Improved "Red Ring" Gear-Lapping Machine

One of the important advantages of an improved "Red Ring" gear-lapping machine designed by the National Broach & Machine Co., Shoemaker and St. Jean Sts., Detroit, Mich., is that a gear having a shoulder, or an adjacent gear on one side, larger in diameter than the gear being finished can be end-lapped. Such an operation is shown in the illustration. Operations of this kind are practicable because the axis of the work-arbor is at an angle with the axis of the shaft on which the lap is mounted. In the particular job shown, the intersection of the axis is about 1/4 inch from the edge of the lap, and so the full length of the gear teeth is acted upon as the gear traverses across the lap.

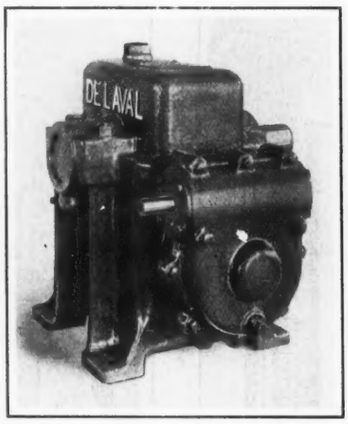
In general construction, the new model closely follows the machine described on page 306 of December, 1931, MACHINERY. An automatic timing device makes it possible to lap every gear in a given lot like the rest and with minimum supervision. The machine can be made to operate with each lap tooth simultaneously in contact with two teeth of the work gear, or with each lap tooth in contact with only one tooth of the work gear.



End-lapping a Gear that is Close to Another Gear of Larger Diameter

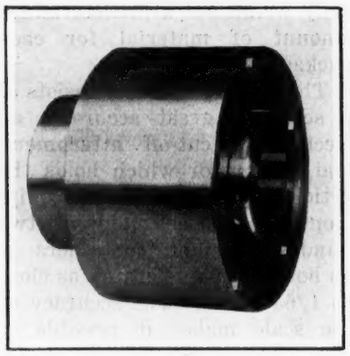
De Laval High-Ratio Worm-Gear Reduction Units

In the new line of double-reduction worm-gear units produced by the De Laval Steam Turbine Co., Trenton, N. J., simplicity of design has been retained, the high-speed wheel being mounted on the slow-speed worm-shaft, but a greater flexibility in the drive has been gained by providing separate housings for the high-speed gear and the slow-speed gear.



De Laval Double-reduction Worm-gear Unit with the Slow-speed Shaft Horizontal

As a result, the unit with the vertical slow-speed shaft can be applied in six different ways: With the high-speed shaft at the right or at the left, the vertical driven shaft can extend either upward, downward, or in both directions. The unit with the horizontal slow-speed shaft can have the high-speed driving shaft, and likewise the slow-speed shaft, extend in either or in both directions. The worm can be rotated clockwise or counter-clockwise. Ratios up to about 8000 to 1 are obtainable.



Kelpo Clutch Coupling of a Free-wheeling Design

Kelpo Free-Wheeling Clutch Couplings

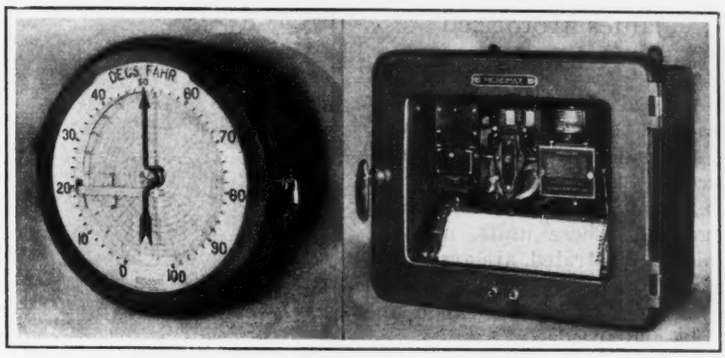
The free-wheeling type of clutch coupling here illustrated, formerly made by the Engineer's Specialty Co., Chicago, Ill., and known as the Columbia one-way clutch, is now manufactured by the Kelpo Clutch Co., 216 Mill St., Rockford, Ill. This device can be used both as a coupling and as a ratchet. It has been applied to machine tools as a ratchet feed for tools when accuracy was an important requirement. The clutch was developed primarily for coupling two prime movers to a common load in such a way that the prime mover not in use automatically comes to rest. In other words, neither prime mover can pull the other.

In the center of this clutch coupling is a gear which, when rotated in the driving direction by the prime-mover shaft, causes a set of cam gears to grip the outer ring and thus drive the load. When the load shaft rotates faster than the prime-mover shaft, or free wheels, the cams allow the ring to slip freely past them. The clutch can be operated in either direction, depending upon how the cam assembly is mounted on the drive gear.

G-M Soldering Iron Stand

The G-M Laboratories, Inc., 1735 Belmont Ave., Chicago, Ill., have brought out a stand for soldering irons which is said to

effect a large saving in power consumption and to overcome soldering troubles by keeping the iron at the proper temperature for use. This stand has two cradles. When the iron is placed in the left-hand cradle, it receives just sufficient voltage to keep it at the proper soldering temperature. By placing the iron in the right-hand cradle, full-line voltage keeps it at the required temperature during use.



(Left) Round-chart Micromax Indicating Recorder.
(Right) Multi-purpose Case for Micromax Recorders

Yale Electric Trucks

Three electric trucks of recent design are being introduced on the market by the Philadelphia division of the Yale & Towne Mfg. Co. One of these trucks is shown in the illustration. The type illustrated has a high-lift swinging crane boom mounted on large rollers. It can be easily swung through an arc of 90 degrees. The crane has a capacity of 1200 pounds in any position. The height of the hook at the end of the boom can be varied from 33 to 102 inches. depending upon the over-all height of the truck.

The second truck is designed for heavy-duty transportation service, having a rated capacity of 10,000 pounds. It is provided with six wheels. Four of the wheels, 10 1/2 inches in diameter by 6 inches wide, are directly under the load platform, while the two driving wheels, 20 inches in diameter by 6 inches wide, are under the battery compartment. All six wheels are steered by a handwheel.

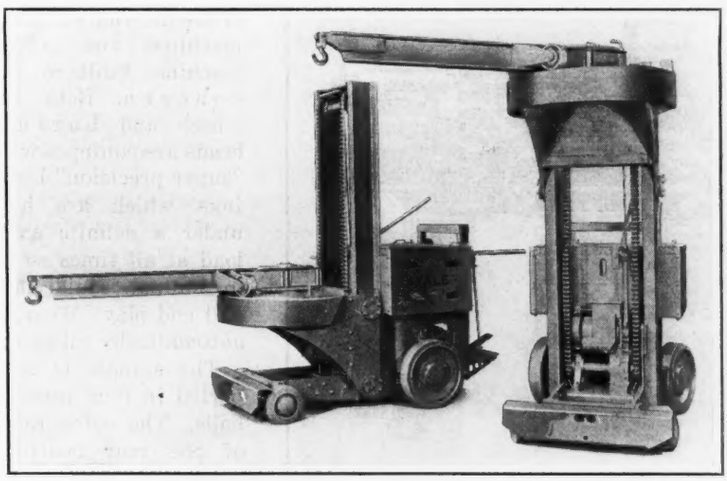
The third truck is of a high-lift tilting-frame type, designed for picking up bulky loads directly from the floor for transportation in a tilted position. This model is made in standard capacity ratings of 4000 and 6000 pounds.

Micromax Indicating Recorders

Four Micromax indicating recorders of a new single-point round-chart type comprised part of the exhibit of the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.. at the Power Show recently held in New York City. One of these round-chart instruments was for recording carbon dioxide in the combustion range; another was for recording pressures over a range of from 0 to 200 pounds per square inch; the third was for recording room temperatures; and the fourth was for recording temperatures from 400 to 900 degrees F.

One of the round-chart indicating recorders is shown at the left in the illustration. It uses a 24-hour circular chart which has straight-line time coordinates instead of curved ones, thus increasing the readability. The case is 16 1/2 inches in diameter.

A new multi-purpose case for the Micromax recorder was also exhibited at the Power Show. This case, which is shown at the right in the illustration, is dust-tight and vapor-tight. It can be supplied for mounting flush in a panel, on the front of a panel, or on a wall, table, or bench. The case is sealed by simply turning the handle. The mechanism can be swung out of the case so that it is accessible from all sides.



Yale Truck with Swinging Boom that can be Raised Horizontally to the Required Height

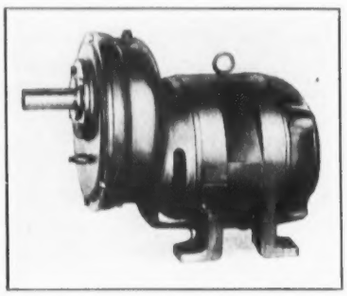
Correction

In the article "Red Ring Gear-Finishing Machine," which was published on page 356 of January MACHINERY, it was stated that the machine corrected the profiles of gear teeth to within plus 0.002 inch of a true involute curve. We are informed that the tolerance should have been given as plus 0.0002 inch.

James Motorized Speed Reducer

A speed reducer in which the gear and the motor are combined in a single unit has been produced by the D. O. James Mfg. Co., 1114 W. Monroe St., Chicago, Ill. These units, one of which is illustrated, are available in sizes from 1/2 to 20 horsepower and in a wide range of ratios and speeds.

The gears used in these speed reducers are of the continuous-tooth herringbone type. They are mounted on anti-friction bearings and run in a bath of oil.

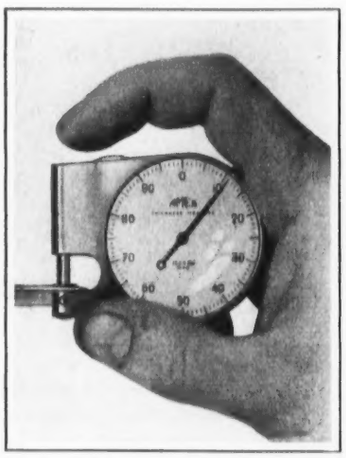


James Speed Reducer with Integral Motor Drive

Ames Thickness Measure

A dial thickness gage designed with a view to providing accuracy, convenience, speedy operation, and adjustability at low price has been brought out by the B. C. Ames Co., Waltham, Mass. The spindle of this thickness measure is raised to open the anvils by turning a wheel at the top. The anvils close with a uniform spring tension when the wheel is released, thus eliminating the element of personal touch.

The dial is graduated to 0.001 inch, so that measurements to 0.0005 inch can be made with ease. Fractional equivalents for the decimal readings of the gage can be obtained by referring to a chart stamped on the back. The gage is made of non-rusting metal and is equipped with an unbreakable crystal. The pointer is adjustable to zero.



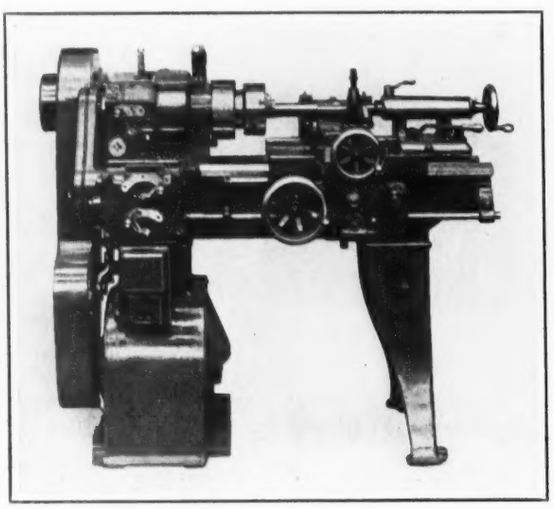
Thickness Gage with Spindle Raised by Turning Wheel

LeBlond Elliptical Turning Lathe

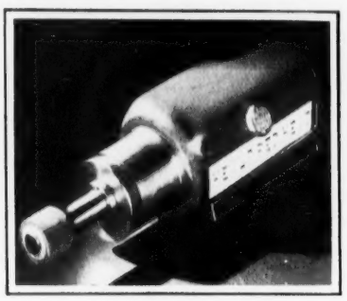
The R. K. Le Blond Machine Tool Co., Cincinnati, Ohio, has developed an elliptical turning lathe suitable for turning punches and mandrels and for boring elliptical holes. The form of the ellipse is determined by the contour of a master cam, and any type of ellipse can be turned or bored by changing the cam.

A standard 11-inch geared-head "Rapid Production" lathe was used as the basic machine. The master cam is rotated by a splined shaft geared to the spindle nose. The roller that contacts with the cam is located in back of it so that the cam pulls the tool into the work.

Long parts can be turned on this machine, the length of the work that can be handled being dependent only upon the length of the splined shaft. Long master cams are not necessary.



Le Blond Lathe Designed for Elliptical Turning and Boring



"Red-Head" Wheel-head for Internal Grinding Machines

Heald "Red-Head" Wheel- and Boring-Heads

Wheel- and boring-heads having the trade name of Red-Head have been placed on the market by the Heald Machine Co., Worcester, Mass., to supersede the previous heads of the internal grinding machines and boring machines built by the concern. Both the wheel- and boring-heads are equipped with "super precision" bearings which are held under a definite axial load at all times so as to eliminate radial slack and end play. Wear is automatically taken up.

The spindle is supported in four rows of balls. The outer races of the rear bearings are free to move axially, thus maintaining proper adjustment un-

der all conditions. The preload is governed by springs and is not altered by expansion or contraction of the spindle due to temperature variations.

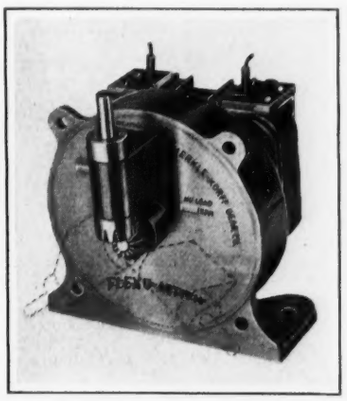
Naked, sleeve, or quill type spindles can be furnished in a variety of sizes for speeds up to 42,500 revolutions per minute. An open pulley construction facilitates changing belts and pulleys without dismantling the head or disturbing its setting on the machine.

Motor Provided with a Vent Pipe at Each End for Ventilation

Motor with Ventilating Pipes

An electric motor specially designed to meet the severe service requirements of installations in which the motor is exposed to excessive humidity, high temperature, abrasive particles, shavings, filings, etc., has been developed by the Ideal Electric & Mfg. Co., Mansfield, Ohio. This motor is a totally enclosed, polyphase, squirrel-cage, induction motor, ventilated by means of pipes at each end.

A large centrifugal fan draws clean air into one end of the motor housing through a vent pipe and discharges the warm air through a vent pipe at the other end. The intake opening may lead to any handy source of clean, cool air, while the outlet pipe may be left free to discharge into the room or it may be connected with the outside. This motor is available in capacities from 1 to 200 horsepower and in 1-, 2-, 3-, or 4-speed styles.



Merkle-Korff Reducer which can be Run in Both Directions

Merkle-Korff Reversible Reduction Unit

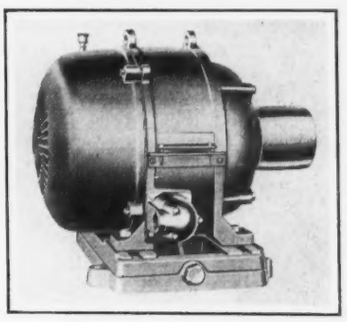
Reversibility is the principal new feature of a speed reducer recently added to the line of reduction units manufactured by the Merkle-Korff Gear Co., 213 N. Morgan St., Chicago, Ill. The integral motor drive consists of a two-pole reversible motor, designed for starting, stopping, and running in either direction, under the control of a simple switch.

The unit operates at a full-load speed of 1500 revolutions per minute and a no-load speed of 2600 revolutions per minute. It can be furnished with horizontal or right-angle drives.

Automatic Oiler Designed for Visible Lubrication of Shafts

Marble-Card Fan-Seal Type Motors

Fan-seal type motors in sizes ranging from 2 horsepower at 900 revolutions per minute to 30 horsepower at 1800 revolutions per minute are being introduced on the market by the Marble-Card Electric Co., Gladstone, Mich. These motors are self-cooling, self-cleaning, self-protecting, and, being entirely enclosed, are free from such hazards as dust, dampness, and fumes.



Fan-seal Type Motor Made by the Marble-Card Electric Co.

The advantages claimed for these motors are that they eliminate the danger of fires and explosions and obviate the expense of special motor housings, boxings or ventilating systems. They can be operated out of doors, in rain or snow, with satisfactory results.

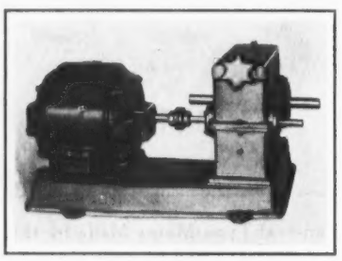
Opto-matic Visible Lubricating System

An Opto-matic oiler, designed for the automatic and visible lubrication of shafts, has been placed on the market by the Trico Fuse Mfg. Co., Milwaukee, Wis. This oiler provides a continuous feed of oil. A wide range of oil levels is obtainable through a micrometer adjustment by merely turning the glass reservoir. It is intended that the reservoir be

filled only annually or semi-annually. The oiler is made in four sizes having capacities from 1 1/4 ounces to 1 pint. It is claimed that the device will eliminate oil-soaked motor windings.

Lenney Variable-Speed Transmission Units

Variable-speed transmission units of the model here illustrated have been placed on the market by the Lenney Machine & Mfg. Co., Warren, Ohio, in capacities up to 1 horsepower. Complete speed flexibility is the principal feature of the new



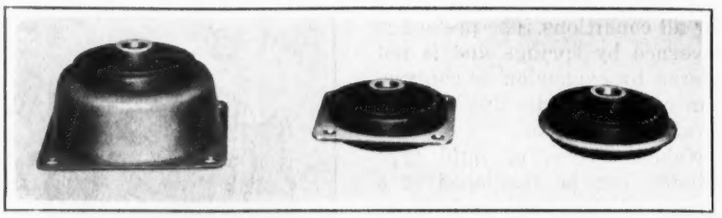
Lenney Transmission Unit, which Provides Infinite Speeds between High and Low Limits

units. The desired speed, even to a slight fraction of a revolution, can be obtained between predetermined high and low limits.

With an input speed of 1150 revolutions per minute, infinitely variable speeds from 10 to 100 revolutions per minute can be obtained, and with an input speed of 1750 revolutions per minute, infinitely variable speeds from 15 to 150 revolutions per minute are available. The unit is not reversible, but it can be built to run in either direction.

Lord Rubber Plate-Form Mountings

Plate-form mountings in the three styles illustrated have been added to the line of bonded-rubber shear-type mountings made by the Lord Mfg. Co., Erie, Pa. They supplement the tube-form mountings described in an article published in April, 1932, MACHINERY, page 561. The plate-form mountings are designed for small machine and instrument installations. They have been applied to motors, motor-generator sets, fans, air compressors, aircraft instrument panels, electric control equipment, etc.



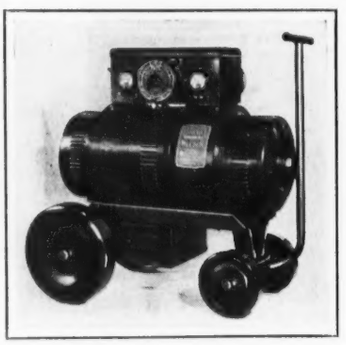
Three New Styles of Rubber Mountings Recently Added to the Line Made by the Lord Mfg. Co.

These plate-form mountings are available in a wide range of capacities. The square plate type in the center of the illustration has four corner holes for fastening purposes; the round plate style at the right is applicable to special holders, and the stamped holder style at the left raises the mounting proper clear of the supporting surface.

Hobart Welder that Uses Plain and Coated Rods

A portable electric arc welder that will handle both coated and plain electrodes has been placed on the market by the Hobart Bros. Co., Hobart Square, Troy, Ohio. While this welder has 60 per cent more capacity than previous models, it costs no more.

The new louvre construction

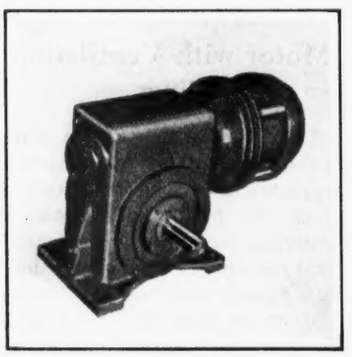


Hobart Arc Welder of Increased Capacity

makes the equipment waterproof, so that it can be used in all kinds of weather. Another important feature is the remote control, which permits the operator to weld 100 feet away from the equipment and still control the welding current with his fingers.

Boston Motorized Worm-Gear Speed Reducer

A motorized worm-gear speed reducer primarily designed to be driven by a standard motor is being introduced on the market by the Boston Gear Works, Inc., North Quincy, Mass. All models



Boston Motorized Worm-gear Speed Reducer

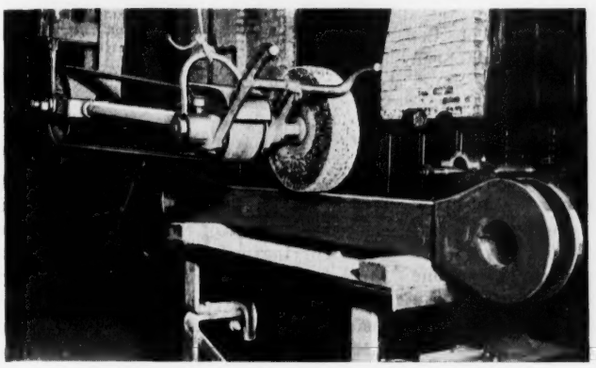
are ordinarily equipped with General Electric motors. Other makes of motors can also be used economically, but only when the complete assembly is produced in quantities. The worm and the motor shaft are made integral to insure quietness of operation and positive alignment.

This speed reducer is available in various sizes, horsepower ratings, and speeds. Compactness, simplicity, and efficiency are the advantages mentioned.

Special Equipment for Polishing and Buffing Large Parts to Reveal Flaws

By H. H. HENSON, Foreman Machine and Erecting Shops
Southern Railway Co.

The side rods and other heavy reciprocating parts of locomotives are polished and buffed to facilitate the detection of flaws or imperfections, as well as to improve the appearance. This procedure is also followed in the production of parts for many kinds of machinery in which the reliability of heavily stressed members is a vital factor. The accompanying illustration shows a swinging type of polishing



Buffing a Locomotive Rod with Special Counterbalanced Buffing Machine Guided by Handle Bars

and buffing machine of simple construction, designed for this kind of work.

Such a machine must be of rigid construction with not less than a 4-inch belt drive, if maximum production is to be obtained with the cushioned type of buffing wheel. The resiliency of a cushioned type wheel is necessary when using this machine, in order to prevent the bouncing effect or up and down movement of the wheel, which produces uneven marks on the highly polished surface. The most efficient size buffing wheel for this class of work seems to be one having a diameter of 14 inches and a thickness of either 3 or 4 inches. This size wheel should be mounted on an arbor 1 or 1 1/2 inches in diameter, and should be operated at 1850 to 1900 revolutions per minute.

The finish obtained depends upon the grain size of the abrasive used on the buffing wheel. For polishing locomotive parts of the kind referred to, it is recommended that a wheel set up with No. 70 grit abrasive be used for the first operation. This may be followed by polishing with a wheel set up with No. 120 grit abrasive. If a highly polished surface is desired, a muslin cloth buffing wheel should be used with a polishing compound.

The polishing machine shown in the illustration is suspended from a countershaft by means of two vertical cross-braced bars of steel, 1/2 by 2 1/2 inches. The frame consists of two U-shaped pieces that support the pulleys and spindle bearings, joined by a piece of heavy steel tubing. One end of the steel tubing is fastened to the U-shaped portion of the housing that supports the large- and small-diameter pulleys. The other end of the steel tubing, which supports the buffing wheel and spindle housing, is connected by means of an adjustable friction clutch. This construction permits the operator to rotate or swivel the buffing wheel in such a manner as to bring it in contact with any portion of the work. The machine is so constructed that it can be swung to and fro on the work.

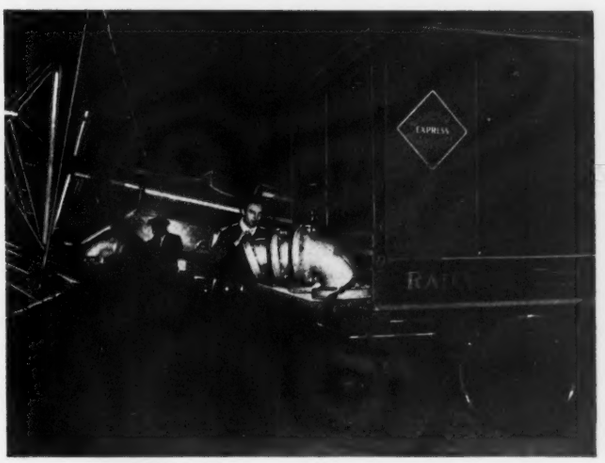
The buffing wheel housing is counterbalanced by a heavy weight suspended by a rope over a pulley mounted between the two upright bars or framework. In polishing a locomotive part such as shown in the illustration, the portable table or truck that supports the work is moved into the position best suited for the operation. The operator holds the buffing wheel housing in position by the handle bars.

The spindle and pulleys of a machine of this kind should be mounted in ball or roller bearings. The bearings must be dustproof. It is very important that the driving belt be at least 4 inches wide, as previously mentioned, in order to permit the operator to apply the necessary pressure without causing the belt to slip.

* * *

Sending Pipe Fittings by Air 1170 Miles Overnight

Due to a breakdown in a sugar refinery at Casper, Wyo., the Crane Co. of Chicago was requested by telegraph to dispatch at once some necessary pipe fittings. By using the air express, an expensive tie-



Loading Pipe Fittings for an Emergency Repair Job on an Airplane for the West, at the Municipal Airport in Chicago

up of the sugar plant was avoided. The shipment, weighing 827 pounds, was turned over by the Crane Co. to the railway express air service late at night. It left Chicago about midnight, and reached Casper before noon the following day. The required repairs were installed before evening.

NEWS OF THE INDUSTRY

Illinois, Minnesota and Wisconsin

KELPO CLUTCH CO., 216 Mill St., Rockford, Ill., has been incorporated to build free-wheeling industrial clutches. The company has purchased the patent of the clutch formerly known as the Columbia clutch from the Engineer's Specialty Co. of Chicago, Ill., and is now in a position to offer short delivery on these clutches.

SCULLY-JONES & CO., 1901 S. Rockwell St., Chicago, Ill., manufacturers of production tools and machinery, have acquired the AMERICAN SPECIALTY CO., of Chicago, manufacturer of "Use-Em-Up" sleeves and sockets.

KERMIT C. PETERSON, 2543 Chicago Ave., S., Minneapolis, Minn., announces a new and improved process for producing metal stampings of any material 0.015 inch in thickness or thinner, in small lots. The process makes it possible to produce a complete set of tools in the same length of time that it would ordinarily take to make a templet for the required part.

WILLIAM G. NICHOL, formerly manager of the Milwaukee office of Neff, Kohlbusch & Bissell, has opened an office in the Mariner Tower, 606 W. Wisconsin Ave., Milwaukee, Wis., where he will handle several lines of high-grade machine tools, cutting tools, and special machinery for cost reduction.

New England

ALDUS C. HIGGINS was elected president and general manager of the Norton Co., Worcester, Mass., at the company's annual meeting January 17, succeeding CHARLES L. ALLEN, who has been general manager of the company for forty-seven years and president since 1919. Mr. Allen now retires from active executive participation in the company's affairs, but as chairman of the Board of Directors will remain in close touch with the company's business activities. Mr. Higgins is a son of the first president of the Norton Co., Milton P. Higgins. He has been associated with the company since 1900, first as manager of the research laboratories, and later as secretary, treasurer, and general counsel. GEORGE N. JEPPSON, vice-president in charge of production, becomes treasurer, succeeding Mr. Higgins.

THOMSON-GIBB ELECTRIC WELDING CO., with factories at Lynn, Mass., and Bay City, Mich., announces that the wire machinery department of the company has been incorporated under the name of THOMSON-JUDD WIRE MACHINERY CO. The new company will be located at Lynn, Mass., and will manufacture a complete line of wire-drawing and wire-rope machinery. The officers are George A. Cutter, president; Josiah Judd, vice-president and general manager; Daniel J. Lyne, secretary; W. T. Ober, assistant secretary; and A. P. Reed, treasurer.

HOWARD COONLEY, president of the Walworth Co., Boston, Mass., has been elected president of the American Standards Association for 1933. Mr. Coonley has been actively connected with the standardization movement for several years, as a representative of the American Society of Mechanical Engineers and of the mechanical industries. Mr. Coonley succeeds BANCROFT GHERARDI, vice-president of the American Telephone & Telegraph Co., as president of the American Standards Association.

FREDERICK G. HUGHES has been made general manager and vice-president of the New Departure Mfg. Co., with plants at Bristol and Meriden, Conn. Previous to becoming connected with the New Departure Mfg. Co., Mr. Hughes was experimental engineer with the Bethlehem Steel Corporation of Bethlehem, Pa., and chief engineer of the Driggs-Seabury Corporation of Sharon, Pa. He is a past-president of the American Society for Steel Treating. Many important inventions are credited to him.

Frederick G. Hughes, General Manager of the New Departure Mfg. Co.

David Ayr, New President of the Hendey Machine Co.

DAVID AYR, formerly manager of the machinery division of the Pratt & Whitney Co., Hartford, Conn., has been elected president of the Hendey Machine Co., Torrington, Conn. He succeeds JOHN A. COE, president of the Waterbury Brass Co. of Waterbury, Conn., who has resigned as president of the Hendey Machine Co. to become chairman of the board. Mr. Ayr is widely known in manufacturing and industrial circles, having had considerable experience in the manufacture of a variety of machine tools and other products.

NORMA-HOFFMANN BEARINGS CORPORATION, Stamford, Conn., in anticipation of an early resumption of activities, has been making ready with extensive additions to its line of Precision ball, roller, and thrust bearings. As a step in the preparation of larger production, John W. MacMorris has been engaged as factory manager. Mr. MacMorris has had many years of production experience, including nine years as factory manager for the Hartford Plant of the SKF Industries.

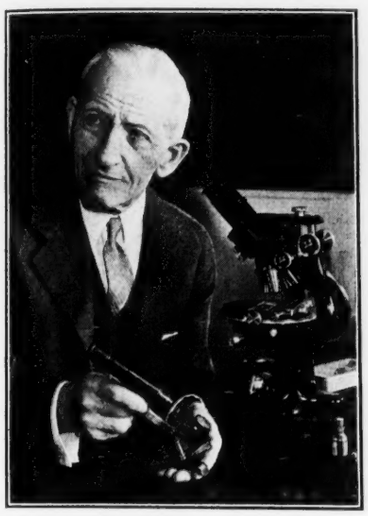
BULLARD CO., Bridgeport, Conn., has granted the General Motors Corporation a license to use the Bullard-Dunn Process for electrolytically descaling metal. This license covers the use of the process in all General Motors' plants, and was executed after an exhaustive practical test of the process in the Cadillac plant at Detroit and in the Research Division of the General Motors Corporation.

RAY H. MORRIS has been appointed factory representative in the Connecticut territory for Hardinge Bros., Inc., and the Morrison Machine Products, Inc., of Elmira, N. Y.

BOSTON GEAR WORKS SALES CO., North Quincy, Mass., announces that the name of the firm has been changed to BOSTON GEAR WORKS, INC.

New York

EDWARD BAUSCH, president of the Bausch & Lomb Optical Co., Rochester, N. Y., was the guest of honor at the annual dinner of the Society of the Genesee at the Commodore Hotel, New York City, January 23. Mr. Bausch, who was born in 1854, is one of America's early micro-



Edward Bausch, President of the Bausch & Lomb Optical Co., Holding in His Hands a Microscope that he Constructed Sixty-five Years Ago

scope builders; when he made his first microscope, there were only eighteen such instruments in the entire country. The Bausch & Lomb Optical Co. began manufacturing microscopes in 1874, and Mr. Bausch has been a leader in the development of optical equipment, and of the mechanical means for producing such equipment, ever since.

ELMER E. GILBERT, sales manager of the Turbine Department of the General Electric Co., Schenectady, N. Y., retired on January 1 after forty-three and a half years of service with the company and with the Thomson-Houston Electric Co., one of its predecessors. Mr. Gilbert directed turbine sales for the General Electric Co. for thirty years.

R. B. BEALE, former assistant manager of the Turbine Sales Department of the General Electric Co., Schenectady, N. Y., has been appointed manager of the Turbine Division of the company, succeeding ELMER E. GILBERT, who has retired.

RALPH T. BUTLER has opened a tool and die shop, known as Butler's Machine & Mfg. Co., at 82-84 N. Division St., Buffalo, N. Y., to engage in repair, welding, and machine shop work in general.

Ohio and Michigan

RAWLPLUG CO., INC., 98 Lafayette St., New York City, manufacturer of screw anchors and holding devices, announces the removal of its Cleveland office and warehouse from 2032 E. 22nd St. to larger quarters at 1315 W. 6th St.

DETROIT GRAY IRON FOUNDRY CO., Detroit, Mich., announces the introduction of a new high-test iron which is not an alloy cast iron, but which, nevertheless, has approximately twice the physical strength of ordinary cast iron, obtained through a process of refinement of the grain in casting. This new iron was developed for use in sheet-metal drawing, with the idea of reducing the weight of the dies by lightening the sections. Numerous other applications have also been found for this product.

EARL L. RAMSEY, who has been in the general sales office of the Ex-Cell-O Aircraft & Tool Corporation in Detroit, Mich., has been made production engineer, working with the sales representatives in the different territories, effective February 1. E. D. WOLF has recently joined the Ex-Cell-O organization and will be in charge of the general sales office. Mr. Wolf was previously connected with the Taft-Peirce Mfg. Co. as assistant superintendent and district sales manager, and with Whitman & Barnes, Inc., as general sales manager.

Oklahoma and Texas

BABCOCK & WILCOX TUBE CO., Beaver Falls, Pa., announces the opening of a district office in Tulsa, Okla., at 2002 Philtower Bldg., under the direction of Carl J. Hochenauer.

O. B. WILSON, formerly manager of the Cleveland, Ohio, office of the Brown Instrument Co., has been appointed district manager of the territory comprising Texas, Louisiana, and southern Arkansas, with headquarters at Houston, Tex.

Pennsylvania and Maryland

NELSON E. CHANCE, formerly district manager of the Houston office of the Brown Instrument Co., 4485 Wayne Ave., Philadelphia, Pa., has been appointed assistant sales manager, with headquarters at Philadelphia. Mr. Chance has been with the company for over ten years, and for seven years was manager of the district comprising Texas, Louisiana, and southern Arkansas.

POOLE FOUNDRY & MACHINE CO., 3701 Clipper Mill Road, Woodberry, Baltimore, Md., has appointed the Rockfield-Davis Equipment Co., 1500 Seventeenth St., Denver, Colo., representative for the line of Poole flexible couplings in the states of Colorado, Wyoming, and New Mexico. Frank M. Esch, P. O. Box 742, Houston, Tex., has been appointed representative for Poole flexible couplings and reduction gears in the state of Texas.

WILLIAMSPORT WIRE ROPE CO., Williamsport, Pa., has been added to the list of wire rope manufacturers licensed to manufacture Preformed wire rope under the American Cable Co.'s patents.

Metal Container Assures Safe Shipment of Ground Hobs

The high-speed steel ground hobs manufactured by the Barber-Colman Co., Rockford, Ill., are now sent to customers packed in individual tin boxes. These boxes insure that the hobs will arrive at their destination without damage. The specifications covering the hob being shipped appear on the outside of the box. Spacers prevent the hob from touching the box at any point. As these boxes are of an attractive design, they are suitable for permanent storage of the hobs on the tool-room shelves.

The Cheerful Side

City Machine & Tool Works of Dayton, Ohio, announce the completion of an order for twenty-one gear-tooth chamfering machines recently purchased by the Dodge Bros. Division of the Chrysler Corporation for the rounding of gear teeth in Chrysler and Dodge transmissions. The National Acme Co., Cleveland, Ohio, reports that it has just obtained an order from a subsidiary of the General Motors Corporation for sixteen 1 3/8-inch four-spindle screw machines. The Link-Belt Co., Chicago, Ill., has received an order from the Moore-Handley Hardware Co., of Birmingham, Ala., for two carloads of Link-Belt chains and conveying and power-transmission machinery.

Machine tool orders in December were better than for any month since last June, and the curve indicating machine tool orders is showing an upward trend. This is all the more significant, since December ordinarily is likely to be a comparatively quiet month.

The production of cars and trucks in December amounted to 102,770, an increase of 66 per cent over November, according to the National Automobile Chamber of Commerce. While the output is still low, it is cheerful to report an increase in production.

OBITUARIES

Christian Gallmeyer

Christian Gallmeyer, president of the Gallmeyer & Livingston Co., Grand Rapids, Mich., died December 2 at the Butterworth Hospital in Grand Rapids, of pneumonia and heart complications, at the age of eighty-two.

Mr. Gallmeyer was born in Adams County, Ind., in 1850. In his youth, he learned the molder's trade in the plant of the Bass Foundry & Machine Co. at Fort Wayne, Ind. In 1877, he went to Grand Rapids, and the next year he was made foreman of the Ottawa Iron Works at Ferrysburg. In 1879, he became partner in the firm of Bryce, Bloeker & Co. of Grand Haven. Ten years later, he returned to Grand Rapids and entered the foundry business as a member of the firm of Remple & Gallmeyer, later the Remple & Gallmeyer Foundry Co., which interest he retained until 1917. In 1912, he became a partner in the Valley City Machine Works, serving as its president until 1923, when the company was merged with the Grand Rapids Grinding Machine Co. and the Union Machine Co., becoming the Gallmeyer & Livingston Co. Mr. Gallmeyer became president of the new company and served in that capacity until his death.

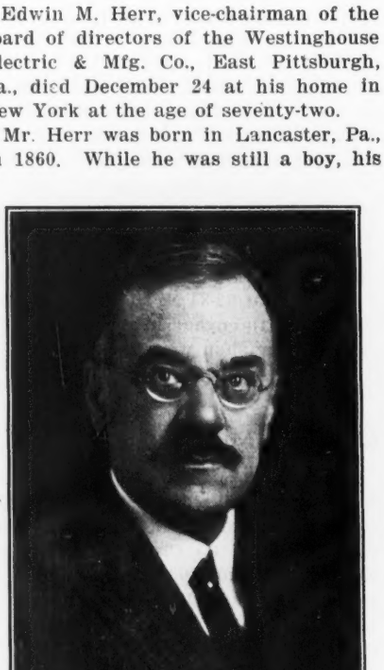
Christian Gallmeyer

Mr. Gallmeyer always took great interest in public affairs. He served as alderman in Grand Haven from 1885 to 1889, and became alderman in Grand Rapids in 1900. In 1917, when the commission form of government was adopted, he was elected a member of the commission, serving seven years, during two of which (1918 and 1919) he was mayor of Grand Rapids.

Edwin M. Herr

Edwin M. Herr, vice-chairman of the board of directors of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., died December 24 at his home in New York at the age of seventy-two.

Mr. Herr was born in Lancaster, Pa., in 1860. While he was still a boy, his parents moved to Denver, Colo. At the age of sixteen, he became a telegraph operator and later a station agent for the Kansas Pacific Railway at Deer Trail, Colo. Studying while so employed, he was able to enter the Sheffield Scientific School of Yale University in 1881, from which he graduated in 1884. He was later employed by the Chicago, Burlington & Quincy Railroad as draftsman, engineer of tests, superintendent of telegraph, and division superintendent. In 1891, he became divisional master mechanic of the Chicago, Milwaukee & St. Paul Railroad, and later became general manager of the Gibbs Electric Co. of Milwaukee. In 1898, George Westinghouse offered him the general managership of the Westinghouse Air Brake Co., and in 1905 he was elected vice-president of the Westinghouse Electric & Mfg. Co., of which he became president in 1911, a position which he held for eighteen years, until he became vice-chairman of the board of directors in 1929. Mr. Herr was also a director of the Radio Corporation of America, the Westinghouse Air Brake Co., and many other organizations.



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Edwin M. Herr

Kate Gleason

Kate Gleason, for many years closely associated with the Gleason Works of Rochester, N. Y., died of pneumonia on January 9. Miss Gleason was born in Rochester, November 25, 1865. She was the daughter of William Gleason, the founder of the Gleason Works. After graduating from the Rochester Free Academy, she entered Cornell University to take a course in mechanical engineering. She left Cornell before completing her course in order to assist her father in his business, and was actively connected with the concern until 1914.

Miss Gleason had charge of the office of the Gleason Works, carrying on a large amount of the commercial affairs of the company, and served as secretary of the concern. She was elected the first woman member of the American Society of Mechanical Engineers, and several times was chosen to represent the Society at world conferences.

Miss Gleason became president of the First National Bank of East Rochester, and also served as a receiver for a Rochester machine tool company, successfully completing the reorganization of the company. She was widely interested in civic work and spent much time and effort on the development of East Rochester. After the War, she engaged in the reconstruction of devastated areas in France. In 1927 she began developments at Sausalito in California, and shortly afterward started improvements at Beaufort, S. C. She is survived by two brothers, James E. and Andrew C. Gleason, and a sister, Eleanor Gleason.

RUDOLPH H. KASPER, for many years well known to MACHINERY'S readers as a contributor of articles on machine shop practice and tool design, died December 21, after a long illness. Mr. Kasper was born in Philadelphia in 1889. After graduating from the Northeast Manual Training High School in 1905, he was employed for five years in the laboratory of the Electric Storage Battery Co., Philadelphia. Subsequently he was with the Foss-Hughes Co. as battery and ignition expert for seven years, and later, was manager of the New Century Auto-Electric Co., Audubon, N. J., for two years. Until his recent illness, he was employed for nine years as tool- and die-maker with the Steel Heddle Mfg. Co., of Philadelphia. He was a frequent contributor to numerous technical journals, and for several years had been doing editorial work for the *Automobile Digest*.

ROBERT C. HANDLOSER, manager of the Detroit office of the Motch & Merryweather Machinery Co., Cleveland, Ohio, died on January 3, after a short illness, at his home in Detroit. Mr. Handloser was born in Trenton, N. J., on October 26, 1875. He graduated from Stevens Institute of Technology, with the degree of Mechanical Engineering in 1898. For about six years he represented a number of prominent machinery concerns in England, Austria, and Germany. In April, 1907, he joined the Motch & Merryweather organization and from that time until his death, was in charge of the Detroit office of the company.

JOHN J. HARTLEY, western division chief engineer of the Link-Belt Co., Chicago, Ill., was accidentally shot and died on December 31. Mr. Hartley was thirty-nine years old. He had been connected with the Pershing Road Plant of the Link-Belt Co. at Chicago for twenty-three years. Following an extensive experience in the engineering and construction departments, he served as sales engineer, and in 1929 was promoted to the position of chief engineer of the western division.

WILLARD S. PADEN, vice-president of the Covel-Hanchett Co., Big Rapids, Mich., died of pneumonia on January 1, at the age of sixty-seven. Mr. Paden had been associated with the Covel-Hanchett Co. for nearly seventeen years, and previous to that had been connected for several years with one of the company's associate factories, the Covel Mfg. Co. of Benton Harbor, Mich. He had been in the machinery sales line for the greater part of his life, and was well known in the machine industry.

ELLSWORTH E. CLARK, foreman of the Metal Stamping Department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., died at his home in Edgewood, Pa., on December 5. Mr. Clark was born at Lima, Ohio, in 1872. He had been actively associated with the Westinghouse organization for twenty-two years, starting with the Westinghouse Machine Co. in 1916. Later, he was transferred to the Westinghouse Electric & Mfg. Co., and in 1920 was made foreman of the Metal Stamping Department.

COMING EVENTS

FEBRUARY 6-8—Office Management and Personnel Conference under the auspices of the American Management Association to be held at Palmer House, Chicago, Ill. Further information from the American Management Association, 20 Vesey St., New York City.

FEBRUARY 19-20—Conference on Welding at the Case School of Applied Science, Cleveland, Ohio. For information, address Fred L. Plummer, Case School of Applied Science.

FEBRUARY 23-24—Second annual Welding Conference and Exhibition to be held in the Industrial Engineering Building, Ohio State University, Columbus, Ohio. Manufacturers of welding equipment and supplies are invited to exhibit. There is no charge for floor space. O. D. Rickly, Director of Engineering Shops, Ohio State University.

MARCH 1-2—Fourth Annual Greater New York Safety Conference to be held at the Hotel Pennsylvania, New York, under the auspices of the Metropolitan Chapter of the American Society of Safety Engineers. Further information can be obtained from Safety Conference Headquarters, 9 E. 41st St., New York City.

MARCH 7-10—Third Packaging Exposition at the Hotel Pennsylvania, New York, under the auspices of the American Management Association, 225 W. 34th St., New York City.

MARCH 8—Regional meeting of the American Society for Testing Materials in New York City. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

MARCH 22-24—Conference on Re-Engineering for Economical Manufacture to be held at the Case School of Applied Science, Cleveland, Ohio. For further information, address Professor E. S. Ault, Case School of Applied Science.

APRIL 26-28—Twentieth National Foreign Trade Convention to be held at Pittsburgh, Pa. Eugene P. Thomas, secretary, 1 Hanover Square, New York City.

MAY 4-6—Annual meeting of the American Gear Manufacturers' Association at Wilkinsburg, Pa. J. C. McQuiston, manager-secretary, First National Bank Bldg., Wilkinsburg, Pa.

JUNE 19-23—Annual convention and exposition of the American Foundrymen's Association at the Hotel Stevens, Chicago, Ill. C. E. Hoyt, executive secretary-treasurer, 222 W. Adams St., Chicago, Ill.

JUNE 25-30—Sixth Midwest Engineering and Power Exposition in the Coliseum, Chicago. Exposition headquarters, 308 W. Washington St., Chicago, Ill.

JUNE 26-29—Semi-annual meeting of the American Society of Mechanical Engineers at the Hotel Stevens, Chicago, Ill. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

JUNE 26-30—Annual meeting of the American Society for Testing Materials at the Hotel Stevens, Chicago, Ill. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

NEW BOOKS AND PUBLICATIONS

MECHANICAL WORLD YEAR BOOK (1933). 361 pages, 4 by 6 inches. Published by Emmott & Co., Ltd., 31 King St., West, Manchester, England. Price, 1/6.

This well-known little pocketbook for the mechanical engineer is now in the forty-sixth year of publication. The 1933 edition contains a number of changes. An entirely new section has been added on internal combustion engines, and another new section deals with bucket elevators. The section on power transmission has been revised and rewritten, and a note has been added on ball bearings for exceptionally high speeds. The section dealing with pipes and tubes has been rearranged to include further data on steel tubes of use in up-to-date power practice.

DESCRIPTIVE INFORMATION IN ANNUAL REPORTS TO STOCKHOLDERS. 56 pages, 6 by 9 inches. Published by the Policyholders Service Bureau of the Metropolitan Life Insurance Co., 1 Madison Ave., New York City.

This report is the third in a series of three studies of the procedure of more than five hundred companies in making an annual accounting to their owners. The present report deals with current practices in describing products, manufacturing processes and improvements, sales trends, new acquisitions, industrial relations, business conditions, and other facts affecting the operation.

EFFECT OF DEPRESSED BUSINESS CONDITIONS ON CREDIT TERMS. 10 pages, 8½ by 11 inches. Published by the Policyholders Service Bureau of the Metropolitan Life Insurance Co., 1 Madison Ave., New York City.

This book is the result of a survey made by the Bureau to determine what changes, if any, have taken place in the credit terms commonly used by manufacturers and wholesalers, and in the retail installment field. It contains an analysis of the experience of more than seventy-five companies in a number of different industries.

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